Loose Policy and Local Adaptation: a Comparative Study of Master Degrees in the Context of the Bologna Process

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DECLARATION

This thesis results entirely from my own work and has not been offered previously for any other degree or diploma

Signature -

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Abstract

The research presented in this thesis focuses on a comparative analysis of six master programmes in Physics in three European countries (England, Portugal and Denmark) in the context of the implementation of reforms triggered by the Bologna Agreement. It undertakes the programme comparison with a particular interest in two dimensions: first, conceptions of master degrees, i.e. what people consider a master degree is, referred to as the ontology of the degree; second, teaching and learning practices as experienced by academics and students, referred to as enacted ontology, determined by an interplay between the ontology of the master and by the process of policy implementation.

Policy-making and implementation has received special attention, since the loose guidance and 'soft' legislative status that characterises Bologna policy (the open method of coordination) has led to different interpretations and a variety of national and institutional responses determined by local or situated circumstances. To capture the transformation of policy and the evolution of actor conceptions at European, national and institutional level, the implementation staircase approach has been used.

The research found that similarities and differences both in conceptions and in teaching and learning practices (manifestations of enacted ontology) emerge as consequences of disciplinary features, national tradition and departmental teaching and learning regimes. In particular, country-specific traditions of university degree organisation appear powerful in shaping the degree's conceptualisation. Differences in conceptualisation between implementation levels (European/national versus institutional) are particularly pertinent in the exemplar discipline of physics. The most notable one refers to the degree's purpose. Whereas the national (and European) levels view the degree as preparation for employment and further studies, physics academics and students describe it more as a springboard to a PhD.

Teaching methods were found to be overall similar, apparently due to disciplinary tradition. A generally low emphasis on transferable skills has been noted, again explained by disciplinary factors. Nonetheless, although physics is a highly-bounded discipline, with relatively strong agreement on its structure, several differences in its 'enacted ontology' have emerged. Thus, assessment practices show discontinuity, sometimes explained by national and sometimes by institutional traditions. Use of learning outcomes is variable, apparently determined by national tradition. There are, too, different approaches to incorporating research in the degree.

This research suggests that *implementation* and *ontology* are mutually sensitive and act together to shape the practices associated with master courses. First, degree conceptualisations (nationally and institutionally determined) exert influence on the interpretation of new education policies and the choices made during implementation. Second, educational policies have the power to shift ontology. New national imperatives can act as catalysts and determinants of new academic practice. Therefore, the expressions of a master degree materialised in recurrent pedagogic practices (the enacted ontology), are produced by a symbiotic intertwining of the two dimensions.

Chapter 1 Introduction

1.1 Background

Over the past decade the Bologna Process has brought winds of change across the higher education landscape throughout Europe. The initiative's endeavours to generate more synergy between national higher education (HE) systems have resulted in significant transformations of the HE sector in several countries, such as reorganisation of degree structures, new higher education qualifications, rethinking of quality assurance and increased emphasis on lifelong learning.

Two of the objectives of the 1999 Bologna Declaration which have received most attention have been the adoption of a system of easily readable and comparable degrees and the adoption of a two-cycle system. Nonetheless, during the following decade, a general consensus emerged that although the degree of structural convergence had increased, the Bologna Process would not achieve the extent of degree compatibility and comparability originally envisaged at the very start (Alesi, Bürger, Kehm, & Teichler, 2005; Kehm & Teichler, 2006). An example of the variation still present in European HE systems is the bachelor-master[1] structure. This study will explore issues of comparability arising from the implementation and translation into practice of master degrees, with an emphasis on the learning and teaching dimension.

Davies argues that although a master template is emerging, a great degree of diversity still characterises its provision (H. Davies, 2009). Plausible explanations are the considerable degree of autonomy and flexibility allowed by the generic qualification descriptors of the Framework of Qualifications in the European Higher Education Area (EHEA) – reflecting a convergence, rather than harmonisation aim – and Bologna recommendations targeting mainly structural features (i.e. length and credit range), giving no detail on actual delivery. Further to a survey of master degrees in Europe, Tauch & Rauhvargers recommended that the master degree in the EHEA should require 'normally the completion of 300 ECTS credits, of which at least 60 should be obtained at the graduate level' (Tauch & Rauhvargers, 2002, p. 7).

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[1] I will employ the term 'master' or 'master degree' as this is the predominant name for the second cycle used in the Bologna Process, rather than the more traditional 'master's' or 'master's degree'.

The 2003 Helsinki conference on master degrees also recommended that a master degree should carry between 90 and 120 ECTS[2]. However, it further stated the minimum requirements for master degrees as 60 ECTS because 'as the length and the content of bachelor degrees vary, there is a need to have similar flexibility at the master level' (Conference on Master-level Degrees, 2003, p. 5).

This flexibility has led to a range of national approaches to the implementation of the new structure of HE degrees based on the bachelor-master progression. A number of studies have undertaken comparisons investigating the degree to which the adopted two-cycle models converge in Bologna signatory countries (Alesi, et al., 2005; H. Davies, 2009; W. Davies, 2007; Tauch & Rauhvargers, 2002). The findings reveal a variety of models displaying 3+2, 4+2 and 3+1 duration patterns, a consensus over the dominant model lacking in the literature. Researchers mainly indicate the prominence of the 3+2 model (W. Davies, 2007; Kehm & Teichler, 2006; Tauch, 2004), but more recent reports also mention 4+2 (Birtwistle, 2009) or five or more years of study (H. Davies, 2009).

Questions have thus been raised about the comparability of degrees envisaged by the Bologna Process. One main point of discrepancy from the predominant model(s) has been particularly frowned upon: the one-year master in the UK[3] set against one and a half or two-year programmes in most continental European countries (W. Davies, 2007; Royal Society of Chemistry, 2008; Tauch & Rauhvargers, 2002; Witte, 2006). This shorter duration has unleashed criticism from continental Europe (Kehm & Teichler, 2006; Tauch, 2004). It has also provoked anxiety in the UK about perceptions that the master is light-weight (Europe Unit, 2004b) and less rigorous (Cemmell & Bekhradnia, 2008) and about the threat that such perceptions might pose to the reputation and competitiveness of UK higher education (Bone, 2008; Cemmell & Bekhradnia, 2008; H. Davies, 2009; House of Commons Education and Skills Committee, 2007a; Johnson & Wolf, 2008; Newman, 2008; Royal Society of Chemistry, 2008; Smith, 2010).

2 Normally 60 ECTS will be assigned to an academic year.

3 The master in Scotland is not deemed contentious given the Scottish 4+1 bachelor-master structure (Johnson and Wolf 2008).

1.2 Emergence of personal research interest and research questions

The controversy surrounding the duration of the UK master caught my attention while working at the Higher Education Academy in the UK. In 2008 I undertook desk research for an inquiry commissioned by the then Department for Innovation, Universities and Skills into the future of UK higher education teaching and the student experience and the medium-future challenges for the sector. Several sources made reference to the one-year UK master and the controversy awakened my curiosity. I had myself studied in HE systems in which a two-year master is the norm (Romania and Denmark) and found it unusual that in the UK the same degree was awarded in less time than what I had experienced myself.

Embarking on a PhD a year later gave me the opportunity to investigate the issue in depth. Besides having a personal interest in the topic, I also found it highly relevant in the context of the existing debate and the scarcity of underpinning research into learning and teaching in master degrees. The comparative studies mentioned earlier mainly addressed descriptors and structural issues, i.e. credit ranges, degree length, typologies, access requirements etc. However, I felt that in order to get to the real essence of a master degree I had to delve deeper into issues of substance. I thus decided to analyse and compare a limited number of master programmes in three European countries by concentrating on learning and teaching aspects. I hoped that by going beyond structural features into finer details I might be able to gain an insight into what really happens on the ground and how study programmes translate into practice through teaching and learning activities. I also hoped that this would help provide a more comprehensive picture of the various factors which shape the overall character of a master degree, of which length is but one. I felt that this in-depth approach would add a new, little explored dimension to comparisons of master programmes undertaken so far. This line of inquiry would also respond to gaps highlighted in literature. Kehm and Teichler (2006) and Davies (2009) identify the need for research into 'substantive convergence' (Kehm and Teichler, 2006), looking beyond structural aspects into content, profile, curriculum, teaching practices, etc.

Moreover, in looking at learning and teaching I believed I would pursue a line of argument advocated by the Bologna Process. Behind the restructuring of HE systems, a more profound desire to embrace a student-centred pedagogy gradually emerges in Bologna documents, manifest in: a mounting emphasis on output (e.g. student competences and skills) rather than input (e.g. teaching time), references to curricular reform and the emergence of learning outcomes as a descriptive feature of degree programmes:

> Governments and HEIs will have to cooperate closely to **ensure that the implementation of the new degree structures is not done superficially**, but is accompanied by the necessary curricular review, taking into account not only the ongoing European discussions on descriptors for bachelor-level and master-level degrees, learning outcomes and qualification profiles, but also institution-specific needs for curricular reform. (Reichert & Tauch, 2003, pp. 11, original emphasis)

However, whether or not the shift towards student-centred education promoted by the Bologna Process is taking place can only be ascertained by investigating what happens at grass-root levels in higher education institutions (HEIs).

Pedagogic practices are necessarily diverse, an expression of national, cultural and institutional factors. Nevertheless, while diversity has been hailed as an asset of European HE, essential to meet the wide range of student needs, institutional resources, employer demands etc. (Kehm and Teichler, 2006), the same diversity might make convergence, and comparison, more challenging than is the case at structural level. Acknowledging this contradiction, Kehm and Teichler (2006) ponder upon the relationship between structural and substantive convergence and upon the reconciliation between convergence and diversity, wondering:

> whether the Bologna Process can aim towards a similar degree of convergence in issues of quality, curricula, teaching and learning, and examinations as in issues of structure of study programmes and documentation of study achievements through credits and diploma supplements, or whether with respect to the former a diversity must be accepted which can hardly contribute to an increased ''comparability''. (Kehm & Teichler, 2006, p. 280)

Against this background, I also hope to explore whether substantive convergence is in fact taking place in a Europe which advocates degree comparability, and whether convergence within diversity is indeed possible. In addition, I aim to investigate whether understandings of master degrees and learning and teaching practices are determined by contextual circumstances rather than by reference to absolute views of master level education and intellectual demand.

Whether or not comparability is becoming reality has much to do with approaches to policy implementation. Referring to the implementation of the two-cycle system, Litjens (2005) remarks that convergence is hindered by the lack of clear guidance and a hierarchical implementation pathway, from European level down to institutional level. Besides, national and local contexts both leave their imprint on the interpretation of policy, resulting in different outcomes on the ground. Veiga and Amaral (Amélia Veiga & Amaral, 2006, 2009a; Amélia Veiga, Amaral, & Mendes, 2008) point on repeated occasions to the contrasting images of implementation encountered on the different policy implementation levels: at the top there is optimism about implementation of Bologna reforms, especially because the passing of legislation is equated with implementation; however this does not automatically imply that institutions implement policy as envisaged. I thus expect views of the master to be influenced by actors' position in the implementation path. Recognition of the different levels shaping implementation – the so-called 'implementation staircase' (Reynolds & Saunders, 1987) – and the modification and adaptation of policy at different levels (European, national and institutional/departmental) have thus become key considerations which have informed the development of this research.

Against this background and personal interest, my research questions emerge as follows:

1. What conceptions do stakeholders at the different levels on the Bologna policy implementation staircase (European, national, institutional) hold of the master and how do these shape the degree's implementation?
2. According to the experience of academic staff and students, what are the continuities and differences in teaching and learning within physics master programmes in different European contexts of practice?
3. What does the comparison between master programmes overall, and physics in particular, suggest about the nature of the degree?

1.3 Research design

In capturing conceptions of the master and their effect on practices, my investigation draws on the sociocultural and social practices approach described by Bamber et al with specific reference to the university sector (2009) and on Geertz's view of cultural interpretation (1973). By adopting an interpretive stance I acknowledge the existence of a variety of subjective meanings held by different people. I also acknowledge the fact that meanings are socially-constructed, therefore formed and revisited through social interaction. One may therefore expect some similarity of conceptions among people in the same country and probably even greater similarity among staff teaching on the same master degree. An interpretive paradigm reflects my intention to discover the influence of cultural, local and individual factors on conceptions, practice and the outcomes of policy implementation with regards to master programmes.

The research concentrates on three countries: England, Denmark and Portugal. The choice has been informed by considerations of variety regarding the level of engagement with the Bologna reforms, pedagogical cultures and geographical locations.

As indicated in the first research question, the study analyses conceptions that decision-making levels involved in policy implementation (European, national, institutional/departmental) hold of master degrees and their influence on practices. Since learning and teaching are areas of departmental responsibility, higher implementation levels (European and national) might not have clear opinions on pedagogic issues, their preoccupations lying mainly with strategy and organisation of HE degrees. Nonetheless, since changing the structure of HE qualifications is expected to trigger changes at the level of degree content and delivery, I also hope to gain an insight into pedagogy-related conceptions held by higher level actors.

At institutional level, the investigated programme is the Physics MSc offered by two research-oriented institutions in each of the three countries. The comparison of learning and teaching practices in the six Physics MSc degrees aims to answer the second research question. The choice of physics was guided by considerations of disciplinary natures. The high degree of consensus over the core knowledge area in physics is expected to facilitate the comparison of learning and teaching issues. I elaborate further on this choice in Chapter 4, also offering a comprehensive account of physics as a discipline and the characteristics that may have relevance for learning and teaching.

The methods employed for data collection were semi-structured interviews and document study. Interviews aimed to shed light on conceptions of the master degree, its implementation, and pedagogy. In addition, departmental level interviews with staff and students unveil the learning and teaching activities involved in the delivery of the programme. Departmental interviews are the primary source for the comparison of the selected master degrees.

In parallel with carrying out interviews, relevant documents at the different implementation levels were considered. Aware of meanings as contextually determined, I opted for what Wellington (2000) calls the 'interpretative' understanding of a text or document as opposed to the 'literal' understanding.

1.4 Supporting theories

Two sets of theories have emerged as relevant to help analyse the translation of master degrees into practice: policy implementation and knowledge representation.

The 'implementation staircase' suggests that policy is perceived differently at each implementation level, resulting in different readings and policy outcomes. In order to clarify this theoretical stance, I have drawn upon a number of authors. First, Ozga (2000) makes a distinction between 'policy research which is relevant and useful to policy makers' and policy research 'concerned with critical and independent analysis of education policy making' which makes policy the subject of scrutiny (Ozga, 2000, p. 4). My study is situated in the latter category.

Ball's distinction between policy as text and policy as discourse (Ball, 1994) conceptualises policy-making as a field in which both agency and structure are manifest, therefore ceasing to be an exclusive government prerogative. Policy as text reflects agency – it is policy interpreted by actors involved in implementation, made as it is enacted. This is reinforced by Trowler's rejection of the rational-purposive model of policy implementation, portraying instead policy-making and implementation as messy processes resulting from conflict, negotiation and compromise (Trowler, 2002). The complexity of factors affecting implementation outcomes is also addressed by Cerych and Sabatier (1986). Simultanousely, Ball's concept of policy as discourse is a reflection of structure, predisposing thought and expression. Whereas Ball, Cerych and Sabatier, and Trowler offer broad theories outlining the context of policy implementation for my research, the 'implementation staircase' (Reynolds & Saunders, 1987) and Vedung's taxonomy of policy instruments (1998) have emerged as particularly useful analysis tools. The implementation staircase becomes a helpful vehicle to take the ‘policy as text’ metaphor a step further and observe policy adaptations as they occur on the different implementation steps. Vedung’s typology of policy instruments – regulation, economic means and information - will assist me in analysing methods employed by actors on the implementation staircase to ensure compliance. These policy implementation theories together provide a rich mixture of concepts which have helped shape the context of my research and guided the interpretation of findings.

In relation to the core preoccupation of this research, the implementation of the master degree, later in the analysis I propose the concept of ‘enacted ontology’ to designate the conceptions and practices which determine the nature of master degrees. I thus refer to the ‘ontology’ of the degree to describe actors’ conceptions related to the knowledge dimension of the discipline and the qualification level, and to ‘enacted ontology’ to describe the pedagogic processes and practices employed in the different settings (i.e. the enactment of the knowledge dimension) under the influence of conceptions.

In order to compare master degrees, the object of the second research question, a theory-informed way of unpacking and describing learning and teaching appeared necessary. Study programmes could be conceptualised as expressions of knowledge classification, articulation, transmission and evaluation. Such a conceptualisation echoes Becher and Trowler’s view of disciplines as knowledge domains (2001) and Bernstein’s ideas according to which educational knowledge is realised through the curriculum, pedagogy and evaluation (Bernstein, 1971, p. 47). In this context theories of knowledge representation acquired relevance and emerged as a pertinent analysis framework.

Michael Eraut’s thinking (Eraut, 1994, 1997) in particular has guided my analysis of learning and teaching in master degrees as manifestations of knowledge. Although developed in the context of professional education, Eraut’s views on knowledge, his classification of knowledge types and modes of knowledge use can also be applied to academically-oriented masters. Eraut advocates a comprehensive definition of knowledge extending beyond that contained in the curriculum (propositional knowledge) and encompassing skills, process knowledge, personal knowledge etc (Eraut, 1994, 1997). This is also the view of knowledge which informs my analysis of master degrees. Eraut also discusses modes of knowledge use – replication, application, interpretation and association – which evolve on a continuum from basic uses of knowledge to increasingly more sophisticated uses (Eraut, 1994). This is another dimension considered in my analysis. In addition, the typology of knowledge proposed by Blackler (1995) – embrained, embodied, encultured, embedded and encoded – also supports the analysis of learning and teaching in master programmes.

1.5 Thesis structure

In Chapter 2 I discuss my epistemological orientation and methodological approach. Chapter 3 elaborates upon the two broad sets of theories which underpin the theoretical framework: policy implementation and knowledge representation. Chapter 4 is dedicated to physics: factors which guided my choice of discipline, the epistemological and socio-cultural features of physics and their bearing on learning and teaching. Chapter 5, 6 and 7 present and analyse the findings which will allow me to answer the research questions, respectively: the reception of the Bologna Process in the three countries, expected to influence the implementation of degrees; actors' understandings of master degrees in different national contexts and at different policy levels; and learning and teaching practices in master degrees. Chapters 8, 9 and 10 are a synthesising discussion and comparison organised around the main concerns of my research: policy reception and implementation; actors' conceptualisation of the master referred to as the ontology of the degree; and the practice dimension reflecting the influence of conceptions, referred to as enacted ontology. Finally, Chapter 11 rounds up the discussion, providing the answers to the three research questions.

Chapter 2 Methodology

2.1 Epistemological considerations

The following epistemological assumptions about the world and human beings inform my research: people make sense of the world by assigning meanings to its components; meanings are constructed through interaction; they are not permanent, logical and clear, but negotiated in context, in interactions and will be different for people operating in different cultural or social settings; and meanings influence practices.

The research questions reveal a two-fold focus of this study: first, it aims to explore people's understandings and conceptions of master education; second, it aims to investigate the translation into practice of master degrees, i.e. adaptations of Bologna policy and localised practice in different higher education settings, influenced by conceptions and understandings. These research aims have guided the choice of an intepretivist paradigm informed by: the sociocultural and social practices approach as described by Bamber et al (2009) with specific reference to the university sector; Geertz's view of cultural interpretation (1973) and Berger and Luckmann's constructionist theories (1967). These theories together construct my epistemological foundation.

Sociocultural theory explains action by invoking the 'shared or collective symbolic structures of knowledge' and a 'socially shared way of ascribing meaning to the world', enabling certain interpretations of reality and certain behaviours (Reckwitz, 2002, p. 246). The sociocultural approach resonates with an earlier theory put forward by Berger and Luckmann (1967) according to which our reality is constructed socially; that is, our experience and knowledge of the world are shaped and maintained through interaction with our fellows. In academia this translates into the fact that people working together develop sets of understandings, values, attitudes and practices particular to their situation; that their discourses are linked to this particular social construction of reality; that their identities both shape and are shaped by interaction with colleagues (Bamber, et al., 2009, pp. 7-8). Thus, practices become reflections of collective ways of knowing and understanding (Reckwitz, 2002, p.250). They are social, developed and cemented in particular settings through interaction, and are unique to a specific situation.

Geertz's (1973) cultural interpretation theory brings a complementary lens of understanding. It is particularly relevant to my consideration of different national settings (English, Portuguese and Danish) and the assumption that cultural dimensions influence conceptions of master degrees and learning and teaching practices. Geertz's theory establishes links between culture, behaviour and meaning. It echoes Weber's concept of 'explanatory understanding' which searches for meaningful connections between people's actions and their underlying motivations (Weber, 1962). Geertz's preoccupation lies in the understanding and depiction of culture by means of 'thick description' of behaviour, which entails not merely observing behaviour superficially, but trying to unravel its deeper meaning, or 'sorting out the structures of signification and determining their social ground and import'. Understanding culture is in his view:

> like trying to read (...) a manuscript – foreign, faded, full of ellipses, incoherencies, suspicious emanations and tendentious commentaries, but written not in conventional graphs of sound, but in transient examples of shaped behaviour (Geertz, 1973, p. 10)

I employ Geertz's interpretation of culture in a somewhat reversed manner. Geertz starts from undertaking thick description of behaviour to inform the depiction of culture; in his words 'society's forms are culture's substance' (Geertz, 1973, p. 28). Drawing on Geertz's correspondence between culture and behaviour, I move in the opposite direction: I adopt culture as an overarching entity, as a 'stratified hierarchy of meaningful structures' (Geertz, 1973, p. 7) which explains the unique ways in which people understand the world, the specific values and beliefs they develop, and their practices. These particular beliefs and practices as expressions of culture are my primary preoccupation.

The analysis of similarities and differences in teaching and learning in the selected master programmes in the different national and institutional settings (likely to be culturally-conditioned) will be informed by recurring practices and narratives emerging from teacher and student accounts. This approach aligns with Geertz's view which advocates anchoring theory in actual occurrences:

> 'if (…) interpretation is constructing a reading of what happens, then to divorce it from what happens – from what in this time or that place, specific

people say, what they do, what is done to them, from the whole vast business of the world – is to divorce it from its applications and render it vacant. A good interpretation of anything – a poem, a person, a history, a ritual, an institution, a society – takes us into the heart of that of which it is the interpretation.' (Geertz, 1973, p. 18)

Therefore, applied to this research, these theoretical underpinnings combined point to a shared collective knowledge and cultural and context-dependent meanings and practices which, together, determine how learning and teaching is conceptualised and carried out in the master programmes in this research. This converges with the notion of teaching and learning regimes (Trowler & Cooper, 2002) I introduce later to help make sense of variation in practices across different settings.

Geertz's spotlight on webs of significance and Berger and Luckmann's construction of reality through social interaction provide an illuminative perspective for the consideration of actors' conceptions of master degrees at different levels of policy implementation. Their conceptualisations of master education will be shaped by the meanings they assign to this qualification level. Meanings, in turn, will be socially constructed within the group in which these actors fare. Hence conceptions are expected to display, on the one hand, variation across cultural, national and situational contexts and, on the other hand, similarity within the same setting. Meanings (and conceptions) are thus formed, transmitted and shared by means of a situated process of social interaction.

Blumer (1969) draws attention to another important aspect, namely that action arises out of a background of people's previous actions. So in order to understand current forms of action, one needs to have knowledge of previous forms of action and consider these into the analysis:

> One is on treacherous and empirically invalid grounds if he thinks that any given form of joint action can be sliced off from its historical linkage, as if its makeup and character arose out of the air through spontaneous generation instead of growing out of what went before (Blumer, 1969, p. 20).

This observation highlights the importance of paying attention to historical circumstances and the reality before the implementation of the Bologna Process and the introduction of the three-cycle system, if applicable, in the countries and universities in this research. Awareness of previous degree strucures and people's perceptions of these can shed light on current conceptions and practices.

The framework for this research thus integrates the following: the sociocultural approach described by Bamber et al (2009) suggesting that understandings and practices are developed within social groups and paying particular attention to the idiosyncratic world of universities; Geertz's (1973) theory of cultural interpretation, a relevant lens for the consideration of three national and cultural contexts and their influence on conceptions and behaviour; and the social constructionist theories proposed by Berger and Luckmann (1967) according to which the creation of knowledge about our everyday reality is mediated and preserved through human interaction.

In summary, this epistemological stance implies that Bologna guidelines and recommendations on master qualifications are reinterpreted and adapted in unique ways by actors at different levels of the implementation staircase on the basis of their interactions and the shared, socially-constructed meanings they assign to education in master programmes. In turn, these meanings are both influenced by and reflected in shared practices which become entrenched within educational settings, explaining continuities and differences in learning and teaching in master programmes as contextually contingent. One may therefore expect similarity of conceptions and practice among, for instance, people in the same country and probably even greater similarity among staff teaching on the same master programme.

In the following sections I will elaborate on the considerations which have shaped the design of my research.

2.2 Sample selection

In discussing theory development through research, O'Donoghue (2007) makes the distinction between 'nomothetic theories' and 'ideographic theories'. The former have predictive qualities and are formulated as general laws of human behaviour, whereas the latter are descriptive and explain particular events or human actions within a specific cultural context (O'Donoghue, 2007, p. 52).

My research aims to develop ideographic theory, as it looks at one particular instance, namely how master degrees are understood and implemented in a small number of cultural and institutional settings. It does not aim to make generalisations beyond the considered cases. This aligns with the approach advocated by Geertz to build theory by closely linking it to the reality it interprets, entailing relevance only within the cases in the spotlight. Thus the essential task of theory-building becomes 'not to codify abstract regularities but to make thick description possible, not to generalise across cases, but to generalise within them' (Geertz, 1973, p. 27).

Developing ideographic theory (as opposed to nomothetic theory) has implications for the number of research participants. A generalisation 'within cases' and concern with particular phenomena within specific cultural contexts has implications for the number of participants required. O'Donoghue thus argues that a smaller number of participants is necessary to generate insights which allow the researcher to speak intelligently about the phenomenon under investigation than if the purpose of the research were to generalise findings to a wider population (O'Donoghue, 2007, p. 56). Therefore, I also believe that for this research a limited number of participants from each of the selected settings is sufficient to build a theoretical understanding of conceptions of master education and teaching and learning practices in the wake of the implementation of the Bologna Process. I do not aim to make generalisations beyond the sample represented in the study. Instead, my intention is to provide a snapshot of conceptions and practices in specific settings which may or may not be indicative of larger trends in the HE sectors considered.

I next elaborate on the deliberations that informed my sample choice.

2.2.1 Country selection

My choice of countries – England, Denmark and Portugal – was initially restricted by language factors. I wished to ensure that I could understand relevant documents (legislation, reports, communications, course specifications, etc.) in the languages of the countries under investigation, should these not have English versions. Moreover, interviews were likely to bring out terminology in the national language, sometimes difficult to translate into English and sometimes value-laden (e.g. degree names in Portugal). Hence, understanding these terms seemed paramount. Indeed, such terminology did come up and familiarity with the language facilitated dialogue.

Geographical location was another criterion, as I ensured that both southern and northern European countries were included.

Subsequently, in choosing these three countries, two main dimensions were considered: first, the countries' perceived level of engagement with the Bologna Process; and second, their positioning on a continuum of pedagogical approaches ranging from traditional, teacher-centred to progressive, student-centred approaches. This latter dimension appeared meaningful for two reasons: the attention that this study pays to teaching and learning aspects of master education, and the fact that the Bologna Process now advocates a new, student-centred pedagogic paradigm. Thus, regarding the two dimensions above, the three countries could be characterised as follows.

Pedagogic paradigm

Bologna engagement		Student-centred	Teacher-centred
	high	Denmark	Portugal
	Low	England	

Figure 2.1 Criteria informing sample choice: engagement with the Bologna Process and pedagogic paradigm

England is perceived as having had a low engagement with the Bologna Process and having adopted a sideline, sometimes aloof, attitude (Dow, 2006; Neave & Amaral, 2008; Sweeney, 2010). At the same time, England promotes and claims to practice student-centred education, as illustrated by the fact that it advocates a characterisation of degrees based on learning outcomes rather than degree length.

Denmark, alongside the other Scandinavian countries, has engaged actively with the Bologna Process. Its HE system has been reformed to align to the Bologna objectives. Regarding learning and teaching, Denmark is among northern European countries known to embrace student-centred education (Reichert & Tauch, 2003, p. 48).

Portugal, too, has fully engaged with the Bologna initiatives and has undertaken a major restructuring of its HE system and governance in the past decade. However, it appears to be still largely characterised by teacher-centred approaches. In fact, Portugal saw the Bologna Process as a window of opportunity to move towards student-centred pedagogy (Amélia Veiga & Amaral, 2009b). This is another reason why Portugal seemed an ideal choice, given the pedagogical transformations in the making.

In each country I selected two Physics MSc programmes to inform the comparative analysis. Reasons for the choice of physics are given in Chapter 4. Given the expectation that an MSc in physics, a traditional academic discipline par excellence, would give weight to research, I chose research-oriented institutions. Therefore, in Denmark and Portugal where the university and the polytechnic sectors co-exist, I chose two universities with strong research traditions. In England, I chose two research-intensive universities, one belonging to the Russell Group and one to the 1994 Group. My sample of physics master degrees thus comprises six programmes altogether.

2.2.2 Participant selection

In order to answer the first research question, participants were selected to represent the levels involved in Bologna policy implementation.

Thus, the European level is represented by actors from the European University Association and from the European Commission. Unfortunately, I did not manage to attract the participation of a European Students Union representative. At national level, I conducted interviews with representatives of key higher education authorities such as ministries, quality assurance agencies, student bodies, universities associations, as well as national representatives on the Bologna Follow-Up Group. At institutional level, I interviewed on average four members of staff teaching on Physics MSc degrees and four students enrolled in the programme. Institutional actors' opinions have informed both the first research question which is concerned with conceptualisations of master degrees and the second and third questions concerned with practice. All in all 65 interviews were conducted (see Table 2.1).

For the national level interviews it was rather easy to identify the appropriate individuals, as roles were public on organisation websites and documents related to the Bologna Process contained references to individuals. However, it was not always the case that the apparently appropriate person was the one I interviewed. I was in several instances referred to other colleagues in the team, which meant that I did not always speak to the person responsible at the highest level. However, I do not believe that this has affected the quality of the data collected. The national interviews were conducted in April 2010 in Denmark (only one in August), in May 2010 in Portugal and in August-September 2010 in England.

Identifying physics master degrees directors or programme leaders was a mixed experience, sometimes rewarding and sometimes frustrating. I used university websites as an initial search tool. In Portugal a key contact's intervention facilitated greatly the task of recruiting departments. In England and Denmark this proved more time-consuming. At times it was difficult to identify the individual in charge of the Physics MSc programmes and I needed help from departmental administrators or central university units. Sometimes I was consecutively referred to different persons. Changes in roles over the duration of my research also meant that I sometimes had to deal with different people at different stages. However, on the whole, once I managed to establish contact with the appropriate person (either a course leader or a master programme administrator), people were willing to take part in the research, although some main contacts reported difficulties in recruiting the necessary number of staff members and students.

One staff member whom I interviewed in all institutions was the master programme director. The other academics were involved in the teaching and/or the supervision of master students. The staff interviews were conducted from December 2009 to May 2010 as follows: England in March 2010; Portugal in December 2009 and May 2010; and Denmark in May 2010.

The majority of students in my sample were approaching the end of their degree. I specifically wished to talk to students at an advanced stage in order to ensure they had a rounded opinion about their degree experience. The timing of the interviews was chosen accordingly, with the following schedule: England in June 2010, Portugal and Denmark in May 2010. In Portugal and Denmark the majority of students were at the end of their second year and writing their master thesis. One student only in Portugal was a first-year master student and one in Denmark had recently completed his master degree. In England, students had recently embarked on their research project and unfortunately they could not comment on this experience. This is a limitation in the data collection, but it was a calculated decision. Since in England the summer months are dedicated to the master thesis, students are not necessarily on campus. Had I waited until the end of the summer, I would have run the risk of not finding enough students to talk to.

European		
European Commission - DG Education and Culture		1
European Universities Association - Policy Adviser		1
England		
National	QAA - Officer	1
	UK Europe Unit - Policy Officer	1
	National Union of Students (NUS) - Head of Education and Quality	1
	Department of Business Innovation and Skills (BIS), HE International (Europe) Team Leader and UK Representative on BFUG	1
	Institute of Physics (IoP) - Director Education and Science	1
Institution 1 (EI1)	Staff	4
	Students	3
Institution 2 (EI2)	Staff	4
	Students	3
Portugal		
National	Ministry of Science, Technology and Higher Education (MCTES) - Secretary of State for Higher Education	1
	Former Secretary of State for Higher Education	1
	BFUG Portuguese representative	1
	Student representative	1
Institution 1 (PI1)	Staff	6
	Students	4
Institution 2 (PI2)	Staff	5
	Students	4
Denmark		
National	Ministry of Science, Technology and Innovation - Special Advisor	1
	ACE Denmark - Special Advisor	1
	Danish Students Union (DSF) - Vice-President, Educational Affairs	1
	Danish Universities (DU) - Special Advisor	1
	Danish Agency for International Education - Special Advisor	1
Institution 1 (DI1)	Staff	4
	Students	4
Institution 2 (DI2)	Staff	4
	Students	4

Table 2.1 Research participants

2.3 Data collection

Two data collection methods were employed: semi-structured interviews and document analysis. Although observation could have given a valuable insight into actual practices, financial and time constraints advised against it. The multiple locations this research considers would have made the task both time-consuming and resource-intensive. Semi-structured interviews and document analysis will be elaborated upon below.

2.3.1 Semi-structured interviews

O'Donoghue states that the important reality is the one perceived by the people and research should focus on those issues which are important for the participants who take part in the investigation (O'Donoghue, 2007, p. 20). Thus, in order to allow issues of concern to participants to surface, I decided to conduct semi-structured interviews. Crabtree and Miller define them as 'guided, concentrated, focused, and open-ended communication events that are co-created by the investigator and interviewee(s)', based on a flexible interview guide (Crabtree & Miller, 1992, p. 16). In semi-structured interviews, despite a sequence of themes to be covered and suggested questions, there is flexibility around the order and phrasing of questions, pursuing participants' answers so as to yield meaningful insights.

Crabtree and Miller's depiction of semi-structured interviews as communication events co-created by researcher and participant is telling. The interview becomes a process of knowledge construction between the two actors, or as Kvale puts it, 'knowledge is created inter the points of view of the interviewer and the interviewee' (Kvale, 1996, p. 124). By delineating the topics to be covered, asking the questions and guiding the interview, the interviewer provides a pre-set framework arising out of his/her interests:

> The interviewer does not merely collect statements like gathering small stones on a beach. His or her questions lead up to what aspects of a topic the subject will address, and the interviewer's active listening and following up on the answers co-determines the course of the conversation. (Kvale, 1996, p. 183)

However, although led by the interviewer, the framework must be sufficiently flexible and accommodating to allow the deep exploration of interviewees' meanings, beliefs and values. Thus, the interview process I chose aligns with Knight and Saunders' constructivist model (1999) which sees the interview as an instance of collaboration and dialogue aimed at helping participants 'bring their tacit understandings to the forefront of consciousness' (Knight & Saunders, 1999, p. 145). It lies on the assumption that participants are not always aware of their tacit assumptions and meanings, hence the role of the interviewer to help make these explicit.

A brief observation on data analysis at this stage: the constructivist perspective is also mirrored by my approach to data analysis, situated within the constructivist variant of grounded theory described by Charmaz (2002). This will be discussed in the next section.

The initial interview guide covered three main broad themes which I felt would provide the information necessary to answer the research questions: the reception of the Bologna Process in the chosen countries and/or departments, as well as motivations, expectations and challenges associated with its implementation, with a specific focus on the degree structure; conceptions of master degrees; and learning and teaching practices in the delivery of master education. As one could naturally expect, actors at the European and national level lack firsthand experience and involvement with actual practices at grass-root level in institutions, being more concerned with high-level policy making and strategic issues of implementation. I did not therefore expect that the pedagogic practices theme could be fully explored in their case; instead it had to be approached at a more abstract level of ideas (or ideals).

2.3.2 Conducting the interviews

A pilot interview was conducted with an academic in a Portuguese university to test whether the questions made sense, were clear and relatively straight-forward to answer. Some minor adjustments were needed. Then, the first set of seven interviews was conducted at two Portuguese physics departments in December 2009.

Visits were undertaken to the institutions to conduct face-to-face interviews, with the exception of the Danish ones. Two successive attempts to travel to Denmark, in April and May 2010, failed due to flight cancellations during the volcanic eruptions in Iceland. Consequently, the interviews with staff and students on the Danish programmes were conducted over the phone. This was mainly out of consideration for the time and effort of the people involved who would have had to reschedule the interviews for the third time. I therefore kept to the second schedule drafted for the face-to-face interviews, but conducted them over the phone instead.

The first interviews conducted in Portugal in December 2009 were fully transcribed to allow an in-depth examination of the data collected in order to generate a comprehensive overview of emerging analytical categories. Equipped with these initial categories, subsequent interviews aimed to explore and expand them. I already had a better idea about what I should be looking for and what leads to follow. The more interviews I conducted, the more I was faced with a dilemma: whether to stick to the same questions and topics throughout all the interviews or whether to add new topics based on insights from the previous interviews. In order to ensure comparability of practices, I decided to preserve the same topics of discussion, but explore further nuances whenever they seemed worthy of investigation. Thus, later interviews were less structured, more exploratory and richer than initial ones. Nonetheless, all interviews addressed the same topics, and therefore I believe that comparability has not been affected. The only drawback is that the initial interviews did not explore in depth aspects that in hindsight emerged as relevant.

Equipped with analytical categories for consideration, the decision not to fully transcribe subsequent interviews seemed reasonable, given the laborious nature of the task. As a result only sections and paragraphs which appeared meaningful were transcribed for the second and third set of interviews (England - March 2010; Denmark - April 2010). Strauss and Corbin also advocate this strategy of ‘selective’ transcribing, stating that the general rule of thumb is only to transcribe as much as is needed. They suggest that whereas it is necessary to transcribe fully the first interviews in order to get guidance for subsequent ones, in later interviews it is acceptable to transcribe only sections which support the emergent evolving theory (Strauss & Corbin, 1990, p. 30). However, later I felt again that I might be overlooking data which in hindsight could be relevant, so I fully transcribed the remaining interviews. I also wanted to follow closely the interview progression to ensure I was not leading or influencing the answers, as I explain in the next section.

All interviews were carried out in English. Participants were briefed in advance by email about the purposes of the study and were given the opportunity to ask questions. Just before the interview I tried to establish a collaborative relationship: participants were again briefed verbally on the research aims; they were given another opportunity to ask questions; their permission was asked to record the interviews; institutional interviewees were reassured of confidentiality; and for the face-to-face interviews they signed a written consent stating that they were willing to participate in the research and could also withdraw at any time.

2.3.3 Inside the interview

I will now report on some aspects which guided the manner in which I conducted the interviews, informed by good practice considerations suggested by Weiss (1994) and Kvale (1996). For instance, I made a conscious effort to ask questions as neutrally as possible and to avoid leading questions encouraging a particular response. I also tried to ask clear questions, avoiding, for instance, questions which contained in themselves multiple ones. I employed tactics of active and attentive listening (Kvale, 1996, p. 135) in order to communicate interest and respect for participants' opinions and to encourage full cooperation. Active listening also allowed me to identify markers, defined by Weiss as 'a passing reference made by a respondent to an important event or feeling state' (Weiss, 1994, p. 77). This was a good strategy to pick up and expand on aspects that seemed emotionally charged and which I believed would lead me towards a better insight into participants' tacit assumptions and values. I also made a conscious effort to intrude as little as possible, for instance not to finish participants' sentences or offer my own associations regarding what was being said.

Weiss emphasises a common-sense issue which I found useful, namely knowing how to manage transitions between themes. He advises against what he calls 'flustering' participants; that is, asking questions which break suddenly their train of thought, create confusion and require re-orientation. This is according to Weiss counterproductive in a qualitative interview situation because one risks losing the depth and richness of accounts:

> I used to tell interviewers who worked for me that they could fluster respondents three times in an interview. Anything more and the respondent would wait for the next question, answer it briefly, and then wait for the next

> question. This is how respondents act in survey interviews. It isn't at all what is wanted in qualitative interviews. (Weiss, 1994, p. 81)

Instead, transitions should be managed either by clearly signposting the introduction of new topics or, if possible, by following the respondents' associations as long as they remain within the interview frame. The semi-structured nature of interviews allowed flexibility around the sequence of topics. Thus, if participants brought up an issue which was further down my list, I would let them expand on it at that point rather than stop them and make them return to it later on. My main concern was to cover all the topics on the interview guide.

Weiss's advice to elicit concrete instances rather than abstract descriptions helped me collect rich, illuminative data. He draws attention to respondents' tendency to give 'generalised accounts', as they believe this is more inclusive and represents better information. However, this can interfere with the researcher's later task of theorising:

> Actually, when respondents provide generalized accounts, their description expresses a kind of theory of what is most typical or most nearly essential (...) By doing this, the respondents pre-empt the investigator's task of analysis." (Weiss, 1994, pp. 72-73)

The interviews ended with a debriefing, allowing participants to ease any anxiety that the conversation might have caused (Kvale, 1996, p. 128). The debriefing was also an opportunity for participants to ask additional questions about the study. In fact, after having done the interview, people's interest was awakened and they seemed much more receptive than at the beginning. Some of them reported to have enjoyed the experience.

Kvale gives valuable advice about how the interview itself can help the later stage of data analysis through a constant process of meaning clarification or 'interpreting as you go'. The value of this exercise resides in the researchers' attempts to confirm or reject their understandings during the interview, a process which 'pushes forward' considerable parts of the analysis into the interview situation itself. Subsequently data analysis will not only be easier, but will also rest on more secure ground (Kvale, 1996, p. 178). I found this advice extremely useful and therefore tried to ensure that by the end of the interview my understanding of raised issues was unambiguous.

2.3.4 Document analysis

The second research method I employed was analysis of relevant policy documents at the different policy levels. At the European level I looked at Bologna declarations and communiqués, at stocktaking reports, at the *Trends* reports produced by the European Universities Association and the *Bologna with Student Eyes* reports published by the European Students Union. At national level, I considered national reports drafted for the Bologna ministerial conferences, higher education legislation, reports and responses to Bologna initiatives authored by governments and national bodies with an HE remit. For the institutional/departmental level I analysed course and programme specifications for physics MSc degrees.

My epistemological stance views reality as being culturally and contextually constructed. I thus start from the premise advanced by Wellington (2000) that documents do not have an essential, objective meaning; on the contrary, meanings are conditioned by the social and cultural context. This is especially true in light of Ball's metaphor of 'policy as text' which highlights how interpretations of policy documents are conditioned by the circumstances, interests and constraints of specific settings (Ball, 1994). So wherever possible, I attempted to dig for the deeper meaning of documents as an expression of tacit cultural or national conceptions and assumptions. So I opted for what Wellington calls the 'interpretative' understanding of a text or document, its connotation, as opposed to the 'literal' understanding, its denotation (Wellington, 2000, p. 116).

2.4 Data analysis

The choice of an interpretive paradigm informed the data analysis method. The search for meaning, for people's conceptions of master degrees and how these influence pedagogic practices, as well as the interpretation which the researcher brings to bear upon these, will inevitably lead to a subjective truth constructed at the interface between researcher and participants. A qualitative researcher, objective as he/she may attempt to be, approaches the research through the prism of their own world outlook and the findings will be coloured by the interaction between this outlook and the participants'. Addison describes the impossibility of totally effacing the subjectivity of the researcher as follows:

> ...interpretation is necessary to understand human action. Truth is not determined by how closely beliefs correspond to some fixed reality. It is never possible to achieve an objective, value-free position from which to evaluate the truth of the matter. Facts are always value-laden, and researchers have values that are reflected in their research projects. (Addison, 1992, p. 112)

Thus, researchers cannot shed their assumptions and values entirely and embark on the research task in a neutral mode. The investigated area will be 'viewed through the experientially engaged and perceptually limited lens of the researcher using a qualitative filter' (Crabtree & Miller, 1992, p. 5). However, being aware of this subjectivity can nonetheless serve to reflect on pre-conceived ideas and beliefs one may bring to the research issues.

This subjective, interpretive stance is reflected in my choice of data analysis method – editing – illustrated by grounded theory (Crabtree & Miller, 1992, p. 20). Editing is one of four qualitative research techniques described by Crabtree and Miller, ranging from techniques that are more objective, scientific and general (valid, reliable, reproducible, systematic, law-like) to others that are more subjective, particular and interpretive (emerging from researcher, personal, context-dependent and meaning-related) (Crabtree & Miller, 1992, pp. 17-21). At one end of the continuum lie the *quasi-statistical techniques* which search the interview text for words or semantic units (usually computer-aided) based on a codebook; these are then manipulated statistically. A second technique is *template analysis* which presupposes the use of an open-ended template or analysis guide which can undergo revision as the analysis of the text progresses. The generation of themes, patterns and interrelationships is an interpretive rather than a statistical process, but the meaningful units in the text are words, phrases and utterances. *Editing* is the third technique and implies a search for meaningful units and a re-organisation of data in categories. It is closer to the subjective/interpretive side of the analysis continuum. The fourth, most subjective technique is *emersion/ crystallisation* and implies the researcher's 'prolonged immersion into and experience of the text and then emerging, after concerned reflection, with an intuitive crystallization of the text' (Crabtree & Miller, 1992, p. 19).

As mentioned above, editing appeared as the analysis style most closely aligned to my research aims. Crabtree and Miller describe it as follows:

> The interpreter searches for meaningful units or segments of text that both stand on their own and relate to the purpose of the study. Once identified, these units are sorted and organised into categories or codes. The interpreter then explores the categories and determines the patterns and themes that connect them. It is often necessary to collect more data during this phase to evaluate the emergent hypotheses. (Crabtree & Miller, 1992, p. 20)

I will now elaborate on *editing* as my choice of qualitative analysis method. As Crabtree and Miller indicate, grounded theory is an example of editing, implying simultaneous processes of data collection and data analysis from the initial phases of research. Its methods provide ‘a set of inductive steps that successively lead the researcher from studying concrete realities to rendering a conceptual understanding of them’ (Charmaz, 2002, p. 675). These steps consist of the pursuit of emergent themes through early data analysis and coding, construction of abstract categories that synthesise the phenomenon in question, further refinement of categories by means of additional data collection and the integration of categories in an overarching theory. It is therefore the emergence of theory from data that gives grounded theory its particular characteristics, as summarised by Strauss and Corbin (1990):

> ...discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon. Therefore, data collection, analysis and theory stand in reciprocal relationship with each other. One does not begin with a theory, then prove it. Rather one begins with an area of study and what is relevant to that area is allowed to emerge. (Strauss & Corbin, 1990, p. 23)

Researchers, however, employ different rules and procedures when using grounded theory. Charmaz (2002) identifies two main variants: the objectivist and the constructivist approach. Faithful to an interpretive stance, I have opted for the latter.

The objectivist approach, as the name suggests, views data as an external reality in the form of objective facts; the researcher’s task is to find them. Researchers are external to the phenomenon under investigation and remain distant from participants. Their role is closer to that of an observer. Therefore, they look for explicit themes, gather findings conceived of as facts and treat the results of their analysis as objective – hence the preoccupation with the stringency of the research process itself and the strict adherence to procedures to ensure the development of an objective, explanatory theory. As Charmaz puts it ‘their role becomes more that of a conduit for the research process than that of a creator of it’ (Charmaz, 2002, p. 677). This approach is illustrated by the quasi-scientific, rigorous and elaborate grounded theory methodology proposed by Strauss and Corbin (1990), which they claim meets the criteria for doing “good science”.

In contrast, the constructivist approach acknowledges that research develops through the shared experiences of researcher and participants reflected both in the data collection and in the analysis. It also places an emphasis on views, meaning, action and the significance of settings:

> Constructivists study how participants construct meanings and actions, and they do so from as close to the inside of the experience as they can get. Constructivists also view data analysis as a construction that not only locates the data in time, place, culture, and context, but also reflects the researcher’s thinking. (Charmaz, 2002, p. 677)

Constructivist grounded theory recognises the researcher as a subjective actor who embarks on the task of learning the meanings which participants assign to phenomena and the effect of meanings on action. It also aligns with the dialogic interview method proposed by Knight and Saunders (1999).

Given my choice of a constructivist approach, I applied the rigorous procedures outlined by Strauss and Corbin (1990) selectively, employing only those methods which I felt would be relevant for my research. In practical terms, this translated into a two-step process: open coding and selective coding. First, I employed open coding on interviews to break down the data into concepts and to generate some overarching categories closely fitting the data. These were continuously explored and verified further through additional interviews, as I explained earlier. The MaxQDA software was used for data coding. Then, selective coding allowed integration of final categories in an all-encompassing, overarching framework. By constantly verifying concepts and relationships against the actual data, the final framework became an expression of those categories and interrelationships that emerged in the data collected, faithful to grounded theory principles.

2.5 Validity and reliability

I would like to dwell briefly on the issues of validity and reliability which appear more problematic in qualitative research. In quantitative research it is rather straight-forward to claim validity by ensuring that research instruments measure what they are supposed to measure, or to claim reliability through replication or consistency of findings, should a similar research be carried out.

The task is less straight-forward in qualitative research. First, the aim here is to illuminate specific phenomena in specific contexts rather than to establish causal relationships or generalisations, hence the uniqueness of research findings. Second, the subjective nature of qualitative research means that different researchers could bring different interpretations to the investigated phenomenon. Thus, in qualitative research it might be more appropriate to replace validity and reliability with credibility and trustworthiness. Crabtree and Miller recommend a number of methods to verify these, like multiple sources (multiple participants, for instance) and 'recycling' the analysis back to participants to check whether it resonates with their views (Crabtree & Miller, 1992, p. 87). This latter aspect is related to what O'Donoghue calls 'reader or user generalisability' (O'Donoghue, 2007, p. 66), namely the readers' ability to relate to the study and gain an understanding of their own or others' situation.

My research paid attention to these recommendations. For instance, I chose several staff members and students within each department to ensure findings drew on shared conceptions and practice. Also, I fed back my analysis to key participants to ensure it matched their views and experience. Moreover, using grounded theory as a method of analysis, i.e. anchoring theory in the actual data, was a measure to ensure the credibility of the emerging conceptual understanding illuminating the concrete reality under investigation.

2.6 Conclusion

This chapter has discussed the epistemological and methodological pillars of this research. The study draws on the interpretive traditions of sociocultural and cultural interpretation theories given the importance these paradigms assign to the social and cultural construction of meanings subsequently reflected in practices. These epistemological assumptions are relevant for the concerns of this research, namely conceptions of master education and practices related to learning and teaching in master degrees in a small number of national, cultural and institutional settings.

Methodological choices have been faithful to my epistemological position. Thus, the data collection methods – semi-structured interviews and document analysis – aim to reveal tacit meanings, assumptions and understandings as they are constructed in specific social and cultural settings. The constructivist variant of grounded theory guided the data analysis process, leading to a construction of reality and an interpretation that acknowledges both the researcher's influence and the meanings interviewees assign to their experiences.

Chapter 3 Theoretical Framework

This research has a two-fold concern: first, it aims to look into conceptions of master degrees held by actors on the different steps of the Bologna policy implementation staircase (European, national and institutional/departmental) and into how these views shape implementation; second, it aims to explore differences and similarities in learning and teaching practices in a number of master degrees and get an insight into the extent to which they are contextually determined and into the degree of convergence in pedagogic practice.

My double research preoccupation led to the choice of two frameworks of understanding as theoretical underpinnings. The first one refers to policy making and implementation which, in the case of the Bologna Process, displays characteristics of 'soft law' (Kupfer, 2008; Ravinet, 2008) and uneven impact in different settings. The second framework is a conceptualisation of master degrees as expressions of knowledge codification, providing an analytical lens for examining and comparing teaching and learning practices and experiences on master programmes. These frameworks complement each other: the former focuses on policy implementation as a *process* in which interpretations and outcomes vary; and the latter on master programmes as both the object and *outcome* of the process of policy implementation. Actors' conceptualisation of degrees influences the implementation process, while implementation approaches, in turn, lead to different expressions of the master degree qualification.

The first theoretical lens views policy-making and implementation as a non-rationalistic and situated process. My argument is framed by Ozga's (2000) understanding of educational policy as contested terrain. I draw predominantly on Cerych and Sabatier (1986), Ball (1994), Trowler (2002) and Trowler, Saunders, & Knight (2004). I also employ the concept of the implementation staircase (Reynolds & Saunders, 1987) and the policy instruments typology proposed by Vedung (1998) as tools to aid my analysis. Situating my research within a non-linear view of policy implementation will help me examine how conceptions of master education evolve as policy moves from European to national and to institutional levels.

The second lens is a theory of knowledge representation based on Eraut's ideas about professional knowledge (Eraut, 1985, 1994, 1997) adapted to the purposes of this study. Master programmes are conceptualised as codifications of educational knowledge. Eraut's categories and classifications serve as ordering tools in the analysis and interpretation of learning and teaching aspects in master programmes. In addition, I also draw upon a typology of knowledge put forward by Blackler (1995).

3.1 A particular case of policy implementation

The first focus of this study captured in the first research question is the transformation of policy as it moves through consecutive levels of implementation. An observation is pertinent at this point.

This research is mainly concerned with what I earlier called issues of *substance* – that is concrete learning and teaching practices on master programmes. However, Bologna guidance addresses issues of *structure* (length, credit ranges, access etc.) and high level descriptors of student achievement on completion of master degrees (Bologna Working Group on Qualifications Frameworks, 2005; Conference on Master-level Degrees, 2003) – thus understandably generic to accommodate national and institutional specificities and requirements. While it can prove helpful as an overarching reference, the design of master programmes, decisions about curriculum, pedagogic practices and educational exchange are the prerogative of departments and academics. Bologna documents make scarce reference to learning and teaching, except for an emphasis on student-centred learning expressed in student competences and learning outcomes.

Therefore, a straight-forward analysis of Bologna policy implementation would imply consideration of structural features of master education, which is only a part of this study. Instead, my main concerns are issues of substance. I thus investigate a particular instance of implementation given the lack of prescription and clear guidelines (reflecting Bologna's concern with convergence rather than harmonisation), facilitated by higher education being a domain which still enjoys considerable autonomy both in national and institutional settings. To use Weick's metaphor, higher education could be described as a 'loosely coupled system' (Weick, 1988) in which individual elements – countries and HEIs – preserve their own identity and characteristics despite contextual changes.

In the countries which replaced traditional degrees with Bologna-compatible ones (i.e. Portugal and Denmark) conceptions are likely to be shaped by people's experience and perceptions of previous degrees. Analysing the evolution of conceptions can reveal consistencies and mismatches among policy-making levels and their practical consequences. Conceptions have a powerful effect on practice. Thus, examining them through the lens of the first research question can illuminate aspects of actual implementation of master degrees in university departments, the latter lying at the heart of the second and third questions.

3.1.1 Research of policy or research for policy?

As stated earlier, Ozga's view of educational policy as contested terrain (Ozga, 2000) represents the context of this research. Ozga distinguishes between policy research which serves policy makers and policy research which adopts a critical and independent view of policy-making, or in her own words concerned with 'making policy in education the subject of scrutiny' (Ozga, 2000, p. 4). My study, driven by a critical exploration of the impact of the Bologna Process on degree comparability beyond strictly structural aspects, embraces the latter approach.

Ozga elaborates further on the above distinction. Drawing on categories proposed by Roger Dale, she discusses three purposes of educational policy research which she calls 'projects': the social administration project, the policy analysis project and the social science project (Ozga, 2000, pp. 38-40). In the following I outline briefly their preoccupations and explain why my research adheres to the third one, the social science project.

The social administration project characterised research into educational policy from the 1940s to the 1970s and aimed at improving practices, especially administrative, of the welfare state. It was inward-looking, preoccupied with national concerns and prioritised collection of facts over development of understanding and theories.

The policy analysis project is research responding to the needs of policy makers: the clients. It focuses on outcomes, searching effective methods of delivering policies:

> ...the policy analyst seeks to meet clients' needs, to define and clarify their problem, to identify options and assess their effectiveness, the likely obstacles to their implementation and their fitness for purpose. The policy analyst is working within the same framework of action as the policy maker, and is concerned with strategic issues. (Ozga, 2000, p. 40)

My research does not fit into either project. The first one has a narrow national focus and is concerned with administrative practices. The second one seems to accept unquestioningly policy makers' objectives and vision of policy outcomes, thus fully attuned to their interests.

However, as mentioned previously, I intend to examine critically the Bologna aim of degree comparability, subsequent guidance, and policy-making and implementation meant to make it reality. My overarching aim is to explore whether master degrees are understood and delivered differently in different contexts (and if so why). I pursue this aim by investigating conceptions of master education (i.e. what is understood by a master degree and expected of a master graduate) held by actors at consecutive levels of policy implementation, and then by considering how these conceptions become practice through policy actions and the actual teaching of master degrees at institutional level. Adopting a critical stance, my research falls within the third project, namely the social science project concerned with understanding how things work:

> The social scientist is not oriented towards a client's definition of the problem. The problem is defined by the nature of existing theory and the orientation is towards improving existing theory. (Ozga, 2000, p. 40)

My research aims to present a tentative theory about a tangible reality, namely how conceptions of master degrees influence learning and teaching practices – later referred to as 'enacted ontology' – and what may explain any observed differences. Ozga's pragmatic view of theory as closely connected to practice and 'normal' life also supports my choice of the social science project:

> We should not, in my view, think about theorizing as though it was an extraordinary or exceptional activity, to be engaged in only in certain conditions, and those to be as far removed as possible from 'normal' life. (Ozga, 2000, p. 43)

Moreover, my choice of the social science project appears sensible as it matches the non-rationalistic view of policy-making and implementation – the policy perspective laying the foundation for this research, thus constituting the 'existing theory' upon which this study attempts to build. The social science project acknowledges the complexity of policy enactment and unpredictability of outcomes. It does not see policy as the preserve of governments and other top authorities, recognising instead that policy is made at all levels – hence Ozga's metaphor of policy in educational settings as contested terrain:

> There are those who understand policy in quite straightforward terms as the actions of government, aimed at securing particular outcomes. I take a rather different, more diffuse view of policy as a *process* rather than a product, involving negotiation, contestation or struggle between different groups who may lie outside the formal machinery of official policy making. (Ozga, 2000, p. 2, original italics)

3.1.2 Conceptualisations of policy and policy implementation

Ozga's perception of policy as involving negotiation and contestation supports the first theoretical underpinning for my research: the situated and non-rationalistic view of policy implementation, whereby disparities occur between policy makers' intentions and grass-root level effects. In this section I discuss this theoretical lens in more detail.

To begin with, Stephen Ball's conceptualisations of policy as text and as discourse prove helpful in the task of unpicking the dissonance between policy intentions and policy effects (Ball, 1994).

Policy as text, inspired in a literary analogy, portrays policy as a representation whose readings vary from recipient to recipient. The policy message is decoded differently and recipients assign meanings according to their experiences and contexts. Trowler (2002) refers to this as the 'situated character of policy reception' (pp. 16-18). Besides, complexity lies not only in the decoding. Policy encoding, too, presents a dimension of complexity, as the final policy text results from negotiation and compromise among different actors involved, or in Ball's words, 'the cannibalised products of multiple (but circumscribed) influences and agendas', with the consequence that 'sometimes the effects of quibbling and dissensus result in a blurring of meanings within texts, and in public confusion and a dissemination of doubt' (Ball, 1994, p. 16). Therefore, neither policy formation nor policy reception occur neutrally, free of preferences, interpretations and contextual circumstances and constraints:

> The physical text that pops through the school letterbox, or wherever, does not arrive 'out of the blue' – it has an interpretational and representational history – and neither does it enter a social or institutional vacuum. The text and its readers and the context of response all have histories. (Ball, 1994, p. 17)

The influence of actors' capabilities, perceptions and preferences on policy formation is well illustrated by Witte's research (2006) into the adaptation of degree structures in four European countries as a result of the Bologna Process.

Ball highlights another issue, namely that policy texts often fail to indicate means or methods. They focus on intended outcomes; beyond that it is up to individual actors to decide on practical actions, largely determined by the characteristics of the local context. Moreover, 'the more ideologically abstract any policy is, the more distant in conception from practice, the less likely it is to be accommodated in unmediated form into the context of practice' (Ball, 1994, p. 19). This resonates greatly with Bologna policy-making, pursuing broad general objectives meant to establish the EHEA; however, countries choose how, when, and in which order they address the objectives depending on national circumstances and priorities. Different responses to policy are encountered, too, when moving from national to institutional level. Legislation establishing Bologna-compatible degrees, when passed nationally as in Denmark and Portugal, provides a broad frame of reference. However, how individual institutions and departments establish the new degrees, the subsequent forms they take and the practices they display will vary from setting to setting.

> Solutions to the problems posed by policy texts will be localized and should be expected to display ad hocery and messiness (...) Given constraints, circumstances and practicalities, the translation of the crude, abstract simplicity of policy texts into interactive and sustainable practices of some sort involves productive thought, invention and adaptation. (Ball, 1994, pp. 18-19)

However, despite the room for manoeuvre policy recipients have at their disposal, Ball draws attention to a sometimes neglected dimension which can set boundaries to interpretation and action. This is *policy as discourse*, a constraint embedded in language. Ball argues that the discourse which policy draws on channels actors to think in pre-set patterns. By putting forward what seem incontestable truths, it inhibits alternative ways of thinking. For instance, in the case of Bologna, an underlying discourse gradually adopted refers to the challenges of the knowledge society calling for the modernisation of the HE sector. Thus, in Ball's words, the manoeuvre and response to policy are restrained from the outset:

> We may only be able to conceive of the possibilities of response in and through the language, concepts and vocabulary which the discourse makes available to us (...) there are real struggles over the interpretation and enactment of policies. But these are set within a moving discursive frame which articulates and constrains the possibilities and probabilities of interpretation and enactment (...) the effect of policy is primarily discursive, it changes the possibilities we have for thinking 'otherwise'; thus it limits our responses to change. (Ball, 1994, p. 23)

When looking at policy from these two different angles – as text open to interpretation leaving room for discretion and as discourse framing mindsets – the interplay between agency and structure in policy implementation comes to the fore, as highlighted by Trowler (2002):

> Agentic understandings of the policy process prioritize actors' perceptions, perspectives, preferences, actions and interactions. By contrast, structuralist perspectives emphasize the ways in which these are conditioned by forces beyond the individual and which consequently give rise to a certain degree of regularity and predictability in social behaviour which would not be present if behaviour were wholly agentic. (Trowler, 2002, p. 10)

The tension between agency and structure, derived from policy being simultaneously text and discourse, offers a useful lens to consider the implementation of the Bologna Process and of master degrees.

3.1.3 The rational-purposive model versus the social practices model of policy implementation

To elaborate on the choice of policy implementation theory underpinning my research, I will discuss the distinction between top-down and bottom-up approaches drawing on Cerych and Sabatier (1986) and Gornitzka, Kogan and Amaral (2005). I will then present two models: the rational-purposive model outlined by Trowler (2002) and the social practices model, as described by Trowler, Saunders and Knight (2004). My research adheres to the latter.

Cerych and Sabatier's book *Great Expectations and Mixed Performance: the Implementation of Higher Education Reforms in Europe* (1986) presents a rationalistic framework of policy formulation and implementation which assumes that fulfilling a range of conditions will lead to the desired results. A number of factors crucial to successful implementation outcomes are identified: clear and consistent objectives, adequate causal theory for goal attainment, adequate financial resources, commitment from officials and affected parties in institutions, resistance of objectives to changing socio-economic conditions. Cerych and Sabatier acknowledge, however, the difficulty of applying top-down implementation theory to higher education. They state that HE reform poses special problems derived from the many autonomous actors present, the multiple interests and the diffusion of authority throughout the structure, rendering higher education 'bottom-heavy':

> 'rarely is the diffusion of authority as great as it is in higher education where, within one system, in addition to a multiplicity of vertical levels of authority there are autonomy-seeking clusters of professionals in law, architecture, business administration, physics, sociology and classics, which are part of small and large, old and new institutions' (Cerych & Sabatier, 1986, p. 256).

In addition, Gornitzka, Kyvik and Stensaker (2005, p. 43) underline that clear and consistent goals are more the exception than the rule and an adequate causal theory is unrealistic to expect, too. Besides, the top-down approach is criticised for adopting a rational understanding of organisations, neglecting actors at the bottom of the pyramid and underestimating their capacities and strategies to adapt policy to their own purposes.

On the contrary, bottom-up approaches consider actors' perceived problems and their strategies to deal with them, acknowledging the disparity between formal policy decisions and practice. As Gornitzka et al explain, in a top-down approach this would appear as 'erring behaviour'. Nonetheless, in bottom-up approaches 'goal displacement' is considered a natural part of policy implementation (2005, p. 44).

The *rational-purposive model*, corresponding to a top-down structuralist view of policy, assumes that intentions are formulated at the highest level and arise from a coherent and clear vision in response to an issue of concern; that translation into practice is either a logical consequence of implementers recognising the value of policy goals or, alternatively, it is steered through levers such as rewards and penalties. This is often the view policy makers tend to adopt, failing to acknowledge the complexity of policy reception (Trowler, 2002). The metaphor employed by Trowler, Saunders and Knight (2004) to illustrate this 'centre-periphery model' is an archer who chooses the target, takes aim and fires; the outcome depends totally on the archer as the chief actor, their abilities and skills.

In contrast, the *social practices model* acknowledges a messy reality of distributed power, corresponding to a bottom-up agentic view of policy in which grass-root actors have room for manouvre. Agency on the ground is just as important as power at the top, not least because the local context with its 'back-stage and under-the-stage deals, knowledge, understandings and attitudes' exerts a significant influence on policy outcomes. The corresponding metaphor is that of sailing a yacht in difficult seas:

> The skipper has the last word, and takes responsibility. But the crew need to be skilled and to take quick decisions. This is particularly so when the going gets really tough. Plans are made, but have to be re-made as conditions change. Decision-making is a moment-by-moment affair, and each one affects the choices available next. As they work together over time the crew and skipper develop particular ways of doing things and often become more effective, but distinctive, in the way they sail. Relationships and practices will be different on board different yachts. (Trowler, et al., 2004, p. 14)

Acknowledging variation in local strategies, practices and relationships – thus bottom-up forces – the social practices model appears significant for my concern with pedagogic practice in master degrees as end products of Bologna policy related to comparable degrees. Moreover, the concept of 'learning and teaching regimes' I introduce next adds even more relevance to the choice of the social practices model.

3.1.4 The social practices model and learning and teaching regimes

Bamber et al (2009) define social practices as 'the recurrent, usually unconsidered, sets of practices or 'constellations' that together constitute daily life'. These could be, for instance, pedagogic practices in master degrees displaying according to the above definition a taken-for-granted, repetitive dimension.

According to Trowler et al (2004) the social practices model of policy implementation suggests that any innovation will be received, understood and implemented differently in different contexts. Applying it to higher education, the authors highlight that discipline, departmental context and history, and individual identities affect policy reception and implementation. In addition, the authors underline that strong inertia characterises educational settings:

> ...existing cultures are extremely tenacious. Inertia is incredibly strong in educational settings. Change in LTAC always involves cultural change — and it's tough. (Trowler, et al., 2004, p. 19)

Trowler and Cooper's concept of learning and teaching regimes illustrates the social practices model (Trowler & Cooper, 2002). It indicates contextual factors determinant of how policy is received and implemented at departmental level, suggesting likely reasons for variation in practices across pedagogic settings. As a result, the concept of learning and teaching regimes appears highly pertinent for the particular focus of my research: conceptions of master degrees and ensuing teaching and learning practices in master degrees within the context of the Bologna Process.

Learning and teaching regimes are defined as a 'shorthand term for a constellation of rules, assumptions, practices and relationships related to teaching and learning issues'. Although expressed in individual behaviour and assumptions, they are 'primarily socially constructed and located and so are relatively enduring.' (Trowler & Cooper, 2002, p. 222) Departments are, according to Trowler and Cooper, the primary location where teaching and learning regimes develop and are transmitted:

> It is here that academics engage together on tasks over the long term. In so doing individuals in interaction both construct and enact culture, many aspects of which are invisible to them because they become taken for granted. (Trowler & Cooper, 2002, p. 222)

The authors discuss a number of learning and teaching regime components, of which four appear relevant for this study. The first one is 'tacit assumptions', for instance on the nature of students in higher education or their abilities. ‘Rules of appropriateness’ are the second component, created and/or received via experiences from the past, setting out what is and what is not appropriate practice in teaching and learning situations. These rules are based on tacit assumptions and become manifest in areas like patterns of classroom interaction, assessment strategies, lecturer behaviour, boundaries of student input to curricular design, nature of student evaluation etc. ‘Recurrent practices’, defined as ‘unreflective habitual routines which are often developed in situ and learned by newcomers during the process of secondary socialisation’, are the third component. These can be practices associated with staff interaction with students, speaking practices in classrooms, giving feedback on assessed work etc. Practices are linked to rules of appropriateness and are based on tacit assumptions, but as opposed to these they represent realised behaviour. The fourth component consists of implicit ‘theories of learning and teaching’, located on a continuum from a teacher-focused transmissive/authoritarian model to a student-focused constructivist/democratic model (Trowler & Cooper, 2002, pp. 229-234).

Components of learning and teaching regimes have a two-fold relevance for my research. First, tacit assumptions in particular may illuminate the conceptions people hold of master degrees. Second, learning and teaching regimes as a whole provide an analytical framework for the second and third research questions around actual teaching and learning practices in master programmes.

It is difficult to depict a fully accurate picture of learning and teaching regimes in the selected master degrees through interviews and document analysis alone, and this might be a limitation of my research. Tacit assumptions, rules of appropriateness and implicit theories of learning and teaching might come across as they exist in reality. However it is difficult, in the absence of observation, to make definite assertions about recurrent practices and realised behaviour. However, consistency between teacher and student accounts can act as a reliability check.

3.1.5 The implementation staircase

The implementation staircase (Reynolds & Saunders, 1987) is a helpful tool illustrating the evolution of policy-making through successive levels. Stakeholders’ location, role and interests shape policy reception and interpretation. The implementation staircase brings out explicitly agency and bottom-up influences and portrays policy recipients as active actors who adapt policy according to their own interpretations, interests and resources determined by their specific contextual circumstances.

The staircase levels in this study illustrating the evolution of conceptions and policy related to master degrees are: the European level (actors feeding directly into Bologna policy formulation), the national level (key national HE bodies and agencies), the institutional/departmental level (staff teaching on master programmes) and students. Reynolds and Saunders' implementation staircase also shows how implementation gaps develop as policy travels along consecutive steps:

> Any idea that (...) policy will look the same at the bottom of the staircase as it looked at the top would be naïve. Instead we find implementation gaps between the changes that are planned in policy, the changes that are enacted in practice, and the changes as they are constructed in the understandings of the students whose learning they were intended to affect. There are differences, invariably, between planned, enacted and constructed changes. (Bamber, et al., 2009, pp. 12-13)

This gap will also be explored by observing differences, if any, in conceptualisation and implementation of Bologna policy on the different policy levels.

Another issue which Reynolds and Saunders draw attention to is actors' tendency to embrace the policy discourse as an easy option to report on actions. They pick up 'justificatory vocabularies' when talking about their practice, while neglecting more genuine reasons and explanations:

> (...) our propensity to share understandings through the adoption of descriptive conventions can be *too* effortless and spontaneous in some circumstances. Thus in most everyday interactions we move *unreflectively* in and out of descriptive conventions, without being able to articulate the ground rules for the application of those conventions. (Reynolds & Saunders, 1987, p. 211)

This evokes Ball's conceptualisation of 'policy as discourse' channelling thought along pre-defined paths, while simultaneously inhibiting alternative perspectives and explanations. It will be worth observing in this study to what extent the official

Bologna discourse permeates actors' accounts on the different levels of the implementation staircase.

3.1.6 Policy instruments

The different levels on the implementation staircase vary in the choice of policy tools meant to ensure compliance with Bologna objectives. Moreover, actors on the same level vary in their choice of policy tools, most notably reflected in national policies and strategies (or lack of) to establish degrees aligned to the Bologna recommendations.

The classification of policy instruments proposed by Vedung (1998) appears useful when analysing the creation of new degrees, since the choice of instrument will affect enactment on subsequent staircase levels. Vedung suggests a three-fold classification of policy instruments based on the degree of 'authoritative force': *regulations*, *economic means* and *information*, or more colloquially, sticks, carrots and sermons. The relationship between 'governor' and 'governees' lies at the basis of this typology and becomes increasingly permissive as one moves from regulations to economic means and to information.

Regulations (sticks) imply an obligation on recipients to act in a certain way, leaving no leeway for alternative action. They are 'measures undertaken by governmental units to influence people by means of formulated rules and directives which mandate receivers to act in accordance to what is ordered in these rules and directives' (Vedung, 1998, p. 31). Laws and decrees fall in this category, and national governments in several European countries have employed these policy instruments to align their HE systems to Bologna recommendations.

Economic means (carrots) leave policy recipients to decide on the course of action. However, financial or in-kind incentives encourage them to choose the option preferred by the authoritative body, as 'economic means make it cheaper or more expensive in terms of money, time, effort, and other valuables to pursue certain actions' (Vedung, 1998, p. 32). So far, economic means have not been applied in the case of the implementation of the Bologna Process, but suggestions of financial incentives have been made by the European Commission in this direction (Neave & Amaral, 2008).

Information (sermons), the third category, is defined as 'moral suasion' and covers 'attempts at influencing people through the transfer of knowledge, the communication of reasoned argument, and persuasion.' Vedung emphasises that information should not be understood exclusively as objective knowledge and facts; it also covers 'judgements about which phenomena are good or bad, and recommendations about how citizens should act and behave' (Vedung, 1998, p. 33). Information is highly relevant in the case of the Bologna Process because of its reliance on discourse and on official monitoring and benchmarking reports as means of generating progress and change. Information is also significant because of Bologna's non-legally binding nature, hence the need for creativity and persuasion to encourage compliance. Vedung's consideration of this policy instrument is welcome, as it names the method employed by the highest policy level on the Bologna implementation staircase. Section 5.1 dedicated to Bologna policy-making considers information as a means of persuasion in more detail. Vedung's attention to this policy instrument is also welcome since it is often neglected in literature:

> It is particularly important that intellectual and moral appeals are singled out as a separate category, since argumentation and suasion, while more and more used, are largely overlooked by the scholarly community. (Vedung, 1998, p. 30)

Importantly, Vedung also discusses the choice of 'doing nothing', or non-interference, as one of the government's options, relevant in the case of England for reasons explained later.

To summarise, this section has described the first theoretical pillar informing this research – policy-making and implementation as a non-linear, messy process – and, consequently, my adherence to the social practices model. I have brought in a number of theoretical perspectives to explain my choice: Ball's conceptualisations of policy as text and policy as discourse, illustrative of the interaction between agency and structure in policy implementation; top-down and bottom-up approaches (Cerych and Sabatier, 1986); the rational-purposive model of policy set against the social practices model, as described by Trowler et al (2004); the learning and teaching regimes illuminative of assumptions and practices; the implementation staircase illustrating policy evolution; and, finally, Vedung's classification of policy instruments. Having moulded the framing of this research, these tools also support the analysis of findings later on.

3.2 Master degrees as forms of knowledge representation

Conceptualising master degrees as codifications of knowledge emerged as an appropriate framework for the comparative analysis of the selected master programmes and the exploration of teaching and learning practices – the object of the second and third research questions. The analysis of master degrees is undertaken from a knowledge representation perspective which concentrates upon how knowledge is understood, articulated and transmitted by the actors involved in the process of educational exchange. This is, therefore, the second theoretical pillar underpinning my research.

The nature and construction of knowledge in educational settings has been discussed for several decades. With reference to school education rather than higher education, Hirst and Peters (1970) analysed educational knowledge already in the 1970s and identified seven epistemological areas distinguished by particular types of concepts and truth verification procedures. Physical sciences are portrayed as one distinctive area, concerned with understanding and knowledge of the sensible world and with truths that 'stand or fall by the tests of observation by the senses' (Hirst & Peters, 1970, p. 63). Becher and Trowler's book (Becher & Trowler, 2001) on academic tribes and territories discussing disciplines as knowledge domains stands in continuation of Hirst and Peters' arguments around types of knowledge. Thus, conceptualising master degrees as forms of knowledge representation follows a long-standing discussion around modes of educational knowledge.

Seeing master degrees as forms of knowledge representation is also relevant for contextual and sociological reasons. People's representations of educational knowledge are likely to be moulded by the setting where they carry out their activities – national, cultural or institutional – and by the process of professional socialisation into the discipline leading to shared meanings, values and assumptions about knowledge. This view is supported by Eraut's ideas according to which learning is:

> situated in a particular context, which comprises not only a location and a set of activities where knowledge either contributes or is embedded, but also a set of social relations which give rise to these activities. This raises the

> important question of the extent to which any given piece of knowledge is individually or socially constructed within that context. (Eraut, 2000, p. 130)

Hence the expectation that knowledge is framed differently in the master programmes in this study, an expectation also supported by the concept of learning and teaching regimes introduced earlier. A focus on situated learning and knowledge also echoes the epistemological stance adopted by this research which portrays meaning as constructed through social interaction and as determinative of actions.

It is primarily Eraut's thinking which frames this theoretical perspective on master degrees as forms of knowledge representation; however I will also draw upon ideas put forward by Blackler (1995).

3.2.1 Types of knowledge

Although Eraut elaborated his ideas within professional education, I believe that they could equally apply to educational knowledge in academic areas. A salutary aspect is Eraut's broad view of knowledge bringing under its umbrella not only traditional educational knowledge codified in textbooks – which he calls propositional knowledge – but also skills, how-to knowledge, tacit knowledge and so on. He rejects a narrow definition of knowledge, instead considering:

> ...the whole domain in which more specifically defined clusters of meaning reside. Thus all the different forms of knowledge (...) – procedural knowledge, propositional knowledge, practical knowledge, tacit knowledge, skills and know-how – are included. (Eraut, 1994, p. 16)

First, this definition of knowledge provides an all-embracing perspective for the consideration of experiences and practices encountered in master programmes. Second, it seems to match the new pedagogic paradigm advocated by the Bologna Process, characterised by an increased emphasis on learning outcomes and an all-encompassing student preparation expressed in knowledge, skills and competences.

I outline next the types of knowledge identified by Eraut indicating wherever pertinent how I tailor them to suit the context of my research.

Propositional knowledge, briefly mentioned above, is explicit knowledge included in education curricula, courses and programmes, ‘identified by its source and epistemological status’ (Eraut, 2000, p. 114), and assigned greater value in the context of formal education (Eraut, 1997, p. 551). According to Eraut, the status enjoyed by propositional knowledge is not related to its socio-economic benefits, but rather to reasons of convenience:

> Some forms of knowledge are easier to describe and assess than others. Some are more easily acquired in formal contexts which offer economies of scale, more reliable quality assurance and simpler arrangements for attributing the costs incurred in the support of learning. These help to provide some explanation of why, historically, more formally recognized forms of knowledge have been given the greatest attention. (Eraut, 2000, p. 552)

Eraut criticises this perspective on knowledge as narrow, promoting its fragmentation; in his words a ‘shopping list model of knowledge representation’ (Eraut, 2000, p. 554). Nonetheless, it is the predominant type of knowledge in higher education, organised around ‘discipline-based theories and concepts, derived from bodies of coherent, systematic knowledge’, ‘generalisations and practical principles’ and ‘specific propositions about particular cases, decisions and actions’ (Eraut 1994, p.103). I anticipate propositional knowledge to be assigned value in the selected master degrees.

Process knowledge is what Eraut calls the ‘knowing how’, as opposed to the ‘knowing that’ characterising propositional knowledge. He enumerates several types of process knowledge within professional education: *acquiring information, skilled behaviour, giving information, deliberative processes (planning and decision-making)* and *meta-processes*. However, one should also be able to recognise most of these processes in the competences expected from students in more academic disciplines.

Meta-processes imply an overview and critical consideration of one’s behaviour and thinking occurring in all the other processes altogether. They appear to require a level of maturity, complexity and critical perspective premature to expect from master students, hence I will not consider them in my analysis of learning and teaching. The other processes, relevant for master education, are outlined below.

Acquiring information relies both on the 'knowing what' and the 'knowing how', thus requiring 'a combination of appropriate propositional knowledge and the ability to select and implement appropriate methods of enquiry'. Background propositional knowledge in a specific topic is essential to guide searches, but students must also possess skills of information collection, retrieval, and interpretation. Eraut names four prerequisites for acquiring information: 'an existing knowledge base in the area concerned', a 'conceptual framework to guide one's inquiry', 'skills in collecting information' and 'skills in interpreting information' (Eraut, 1994, p.108). Given its concomitant reliance on propositional knowledge and inquiry, both necessary components in master education, I would expect acquiring information to feature prominently in the teaching and learning practices of the selected master programmes.

Skilled behaviour, defined as 'a complex sequence of actions which has become so routinized through practice and experience that it is performed almost automatically' (Eraut, 1994, p. 111), applies to areas such as interpersonal or communication skills. Skilled behaviour is acquired through practice and feedback on one's practice; it involves tension and stress in the early stages of skills acquisition, but eventually becomes routine or 'tacit knowledge'. Gradually one develops situational understanding and the ability to intuitively adapt responses and behaviour to circumstances. In my later analysis, the development of skilled behaviour as an element of student preparation (e.g. group work, oral skills, presentation skills etc.) constitutes one aspect of investigation.

Eraut presents *giving information* as a stand-alone category within process knowledge because of its crucial relevance in professional practice given constant interaction with customers (e.g. doctors or lawyers). However, in the context of academic degrees such as the physics MSc, usually populated by students early in their careers, it appears more appropriate to subsume giving information to the skilled behaviour category and understand it as the ability to communicate information to specialised and non-specialised audiences.

Deliberative processes include activities such as analysing, planning, problem-solving, evaluating and decision-making. As with acquiring information, propositional knowledge is a sine-qua-non condition to exercise deliberative processes, but these also require situational understanding and judgement. In the case of research-oriented academic education, deliberative processes could be higher-level exercises when decisions have to be made about, for instance, the line of inquiry to pursue or the relevance of a specific topic for research. Deliberative processes are, according to Eraut, employed in circumstances which present some uncertainty about outcomes, in which guidance from propositional knowledge is only partially helpful and which provide insufficient contextual knowledge (Eraut, 1994, p. 112). Contextual ambiguity triggers the need for analysis, evaluation of possible solutions and decision-making. Again, exposing students to deliberative processes is envisaged to play an important part in teaching and learning activities in master programmes. Academic master degrees usually contain a research component, hence the expectation that students should be capable of thinking critically, weighing options, making informed decisions and using limited knowledge in new, uncertain situations as they emerge in research.

An additional typology of knowledge developed by Blackler (1995) could also prove helpful in analysing knowledge valued and imparted in master programmes. Blackler identifies five categories of knowledge: embrained, embodied, encultured, embedded and encoded. I briefly present each of them below and indicate why I consider them relevant for my research.

Embrained knowledge is ‘dependent on conceptual skills and cognitive abilities’ (Blackler, 1995, p. 1023). Blackler portrays it as abstract and high-level, enjoying a unique status in the western world, standing in opposition to knowledge which informs routine behavioural processes. He calls the latter *embodied knowledge*: action-oriented, acquired by doing, rooted in specific contexts, expressed in ‘techniques which depend on an intimate knowledge of a situation rather than abstract rules’ (Blackler, 1995, p. 1024). These two types of knowledge mirror the higher-level and lower-level learning defined by Fiol and Lyles (1985). Lower-level learning is surface learning which occurs through repetition, involves routine, results in a particular behavioural outcome and presupposes a well-understood context. In contrast, higher-level learning is non-routine: it requires an understanding of causation and complex associations, changes assumptions and frames of reference and happens in an ambiguous context (Fiol & Lyles, 1985, pp. 809-810).

Embrained knowledge contains elements of Eraut’s propositional knowledge, but also process knowledge such as acquiring information and deliberative processes requiring critical judgment, whereas embodied knowledge might somewhat correspond to skilled behaviour. In my later I will keep both these categories in mind:

I expect embrained knowledge to figure prominently in students' preparation, but embodied knowledge might also be relevant in the context of skills development.

Whilst embrained and embodied knowledge might be helpful in defining what students are expected to know/ be able to do, I anticipate the next two categories, encultured and embedded knowledge, to illuminate staff practices and assumptions about the value of specific types of knowledge and training.

Encultured knowledge is implicit knowledge acquired through social interaction within a community through processes of 'socialization and acculturation' (Blackler, 1995, p. 1024). It consists of socially-constructed meanings shared in a community, in this case the academic communities united in the task of teaching master degrees. Nevertheless, shared understandings may exist at different levels: within an academic department (learning and teaching regimes), within the specific disciplinary culture in physics (the academic tribe) or within a particular national tradition. Encultured knowledge could thus explain conceptions of master education analysed in the context of the first research question, and can also illuminate practice and experience when comparing pedagogic aspects in the chosen master degrees in the context of the second and third research questions.

Embedded knowledge is knowledge contained in organisational systems, processes and procedures, or as Blackler puts it, 'analysable in systems terms, in the relationships between, for example, technologies, roles, formal procedures, and emergent routines' (Blackler, 1995, p. 1024). Processes and procedures characteristic of specific institutions or departments will at least partially explain teaching and assessment practices, hence the significance of embedded knowledge for this study.

Encoded knowledge, according to Blackler, is represented by books or manuals, as the more traditional forms, and electronic information resources; it is 'highly selective in the representations it can convey' (Blackler, 1995, p. 1025). The concept of encoded knowledge may come handy when analysing the syllabuses and curricular composition of the different programmes in order to compare the knowledge deemed necessary for students.

Alongside the types of knowledge outlined so far, modes of knowledge use also inform my analysis.

3.2.2 Modes of knowledge use

I draw again on Eraut to describe how knowledge is employed in master degrees. While the discussion around knowledge types concentrated on what could legitimately fall under the umbrella of knowledge, modes of knowledge use illustrate staff expectations about how students should employ the knowledge acquired during the degree.

Eraut proposes four modes of knowledge use: replication, application, interpretation and association (Eraut, 1985, pp. 124-125).

Replication, as the term indicates, implies no difference between knowledge acquired and knowledge used; it is simply replicated and regurgitated. Using knowledge does not require processing, re-shuffling or re-packaging. According to Eraut, replication dominates schooling and higher education to a large extent, so that what students present for assessment is similar to what they have received. This may be encountered in traditional HE systems based on a knowledge transmission model, probably more at undergraduate level. It would be surprising if it characterised teaching and learning in master education, supposed to develop critical, independent thinkers.

Judging by the term alone, *application* could mean using knowledge in an applied context. Eraut, however, argues that application is more than that. It involves applying knowledge in new, unfamiliar circumstances with regard to a set of rules and procedures. If application of knowledge were to become repetitive and routine, it would become replication. The result of application is a translation of knowledge into practical action. In the case of physics master programmes, application of knowledge might be encountered in employing research methodologies to address specific problems.

Interpretation involves understanding and judgement, modifying the knowledge received and setting it into perspective. Theory and concepts are not absolute representations, rather the raw material subsequently processed, re-worked and re-conceptualised according to individual lenses. Anyone can bring their own interpretation on theory:

> Concepts, theories and intellectual disciplines provide us with ways of construing situations; and our understanding is shaped by the interpretative use of such theoretical knowledge. Perspectives or ways of seeing provide the basis for our understanding of situations and hence the grounds for justifying our actions, but cannot be simply designated as right or wrong. (Eraut, 1985, p. 124)

The interpretive mode of knowledge use should be particularly relevant in master degree teaching and learning given the expectation that higher level learning (Fiol & Lyles, 1985) and deliberative processes (Eraut, 1994) are valued, indispensable in inquiry-oriented programmes.

Association, the last mode of knowledge use, might be less relevant for master education, as vast practical experience is a pre-requisite. Eraut describes association as an advanced mode of knowledge use implying a move from practice to theory. It involves visual associations derived from practice - what Eraut calls metaphors and images as 'carriers for theoretical ideas'. He gives the example of progressive education which has been represented through powerful images rather than through theory (Eraut, 1985, p. 125).

This section has elaborated on my second theoretical underpinning: the conceptualisation of master degrees as forms of knowledge representation. First, it outlined Eraut's all-inclusive concept of knowledge providing the lens for viewing master degrees as knowledge codifications. Second, it considered two typologies of knowledge developed by Eraut and Blackler. Third, it has depicted modes of knowledge use, also drawing on Eraut's thinking. These three dimensions guide my analysis and comparison of teaching and learning practices on the selected master degrees, helping explore teachers' and students' conceptions of knowledge and how these translate in actual activities. Considering Bologna's ambition to shift the pedagogic paradigm towards a student-centred one, these tools may also be indicative of the degree to which observed teaching practices and student experiences reflect student-centred learning or a more traditional knowledge transmission model.

To conclude, I will briefly summarise how the two frameworks of understanding discussed in this chapter assist me in answering the research questions. In an attempt to reduce disparities among national HE systems in Europe, the Bologna

Process employs broad reference frameworks and ‘soft’ implementation strategies relying on discourse and persuasion. However, given the variety of national, cultural and institutional settings as Bologna policy receivers, it is legitimate to wonder how successful soft tactics are in bringing about convergence. Learning and teaching in master degrees, the Bologna second cycle, are the one dimension of convergence this study explores. In this context, the first research question looks at the evolution of policy and conceptions of master education on the different steps of the implementation staircase. Thus, the first framework of understanding – policy-making and implementation as a non-rationalistic, localised process – is a useful perspective which can help contextualise and explain a *process of implementation* leading to variations in reception, interpretation and adaptation of policy on consecutive levels. The second framework of understanding concentrates on the *object of implementation* – master degrees – and conceptualises them as context-determined forms of educational knowledge. Given the envisaged variety of perspectives on what constitutes master knowledge and education, this conceptualisation of master degrees provides an ordering axis for the comparison of master degrees (the object of the second and third research questions).

Chapter 4 Physics

4.1 Why physics?

Initially my intention was to undertake parallel comparisons of master programmes in two disciplines, one in sciences and one in social sciences or humanities. However, it early became obvious that PhD constraints would not allow a comprehensive comparative analysis across two disciplines. The qualitative methodology based on interviews would have been time-consuming at all stages: data collection, processing (transcription) and analysis.

Several considerations guided my choice of discipline. In order to facilitate the comparison of learning and teaching, the first decision was to leave aside disciplines with a powerful cultural baggage whose curricula are likely to be influenced by national or cultural contexts, such as literature and languages. An additional demarcation was that between academic and professional disciplines. I decided against professional disciplines for a number of reasons. First, my intention was to limit the research to the university sector, and I felt this would justify the choice of a traditional academic subject. Had I decided to look at professional disciplines, also offered in the non-university sector or specialised schools, I would have had to extend the scope of the research beyond the university sector (binary sectors are a reality in many European countries, including Denmark and Portugal). Second, EU legislation currently regulates more than 800 professions through Directive EC/2005/36 on the Recognition of Professional Qualifications. This does not acknowledge the Bologna Process developments and, crucially, does not align with the FQ-EHEA which describes bachelor, master and doctoral degrees (European Universities Association, 2007). Third, my decision was reinforced by the fact that professional disciplines are subject to the intervention of professional bodies who limit the autonomy of HEIs to define their programmes, thus widening the scope of research and requiring the inclusion of additional dimensions and actors in the analysis.

Thus my choice of discipline was informed by the following preoccupations: to facilitate a comparison focused on the learning and teaching component of master degrees, to concentrate on the university sector and to limit external input into curriculum and learning design.

After some preliminary searches, I shortlisted four academic disciplines: Maths, Physics, Economics and History. Further to advice from the Higher Education Academy's Subject Centres about European developments underway linked to Bologna, the shortlist was reduced to two: Physics and Economics. The final choice of Physics was based primarily on two considerations. First, as one overall aim of the Bologna Process is to increase staff and student mobility, it felt appropriate to choose a discipline already enjoying high levels of research and teaching mobility. Physics is in this sense more fortunate than Economics, not least because European Commission funding is largely directed towards science and technology (Keeling, 2006). The second consideration, weighing more heavily, was related to the nature of the discipline. Physics is a highly defined subject, the academic community sharing agreement over its core structure, methodologies and epistemological position. I expected that this consensus would make physics less problematic to tackle, facilitating a focus on the comparison of learning and teaching.

4.2 Physics as a discipline

This section considers the characteristics of physics as a discipline providing the background for the learning and teaching analysis. Two conceptual frameworks have emerged as relevant. First, I will refer to Bernstein's concepts of classification and framing and situate physics in relation to them (Bernstein, 1971, 2000). Second, I will complement this approach with the disciplinary classification framework outlined by Becher and Trowler in their study of academic tribes and territories (Becher & Trowler, 2001).

4.2.1 Physics in disciplinary typologies

Bernstein introduces two concepts to describe educational knowledge: classification and framing. Classification refers to the relationship between areas of knowledge, namely the degree of separation between discrete knowledge areas (or curriculum content):

> Classification refers to the nature of the differentiation between contents. Where classification is strong, contents are well insulated from each other by strong boundaries. Where classification is weak, there is reduced insulation between contents for the boundaries between contents are weak or blurred.

> *Classification thus refers to the degree of boundary maintenance between contents*. (Bernstein, 1971, p. 49)

Whereas classification describes content, framing describes pedagogy, i.e. how transmission of educational knowledge takes place. It characterises the pedagogical relationship between teacher and students, as well as the degree of control held by the two parties regarding what is transmitted and received and how. Like classification, framing can be strong or weak, with power on the teacher's or the student's side:

> Frame refers to the specific pedagogical relationship of teacher and taught (...) to the range of options available to teacher and taught in the *control* of what is transmitted and received in the context of the pedagogical relationship. Strong framing entails reduced options; weak framing entails a range of options. *Thus frame refers to the degree of control teacher and pupil possess over the selection, organisation and pacing of the knowledge transmitted and received in the pedagogical relationship*. (Bernstein, 1971, p. 50)

Wide agreement about the core knowledge of physics reported in literature (Becher, 1990; Becher & Trowler, 2001; Kekäle, 1999) supports the claim that it is a strongly classified discipline. Becher (1990) lists a limited number of areas of overlap occurring, for instance, between physics and engineering (solid-state materials) and physics and biology (the structure of proteins), as well as between theoretical physics and mathematics. However, as overlap is the exception rather than the rule, he concludes that outside the border zones, the contrasts are clear. Mathematics is perceived as 'more rigorous (...) but lacking in the concern with reality' characteristic of physics, this 'sense of concreteness' leading many physicists 'to hold their subject superior to one which involves "making chicken scratches on paper" (Becher, 1990, p. 3). Suggestive of the physicists' pride in their identity, Becher's investigation of several disciplines revealed physics as the only one which acknowledges hierarchies of esteem between disciplines, disputing the first ranks with mathematics and philosophy. A direct consequence of the strong boundaries surrounding physics is, therefore, an acute sense of identity and belonging to a community, also documented by Bernstein (1971) for classified knowledge areas. In a study based on interviews with university physicists (Becher, 1990) this sense of identity is presented on a continuum ranging from 'theism' or a 'quasi-religious belief', to 'common foundations in history and common core in the undergraduate syllabus' and the more pragmatic sharing of apparatus between different groups, thus a 'functional unity'.

The strength of framing in physics cannot be ascertained as convincingly. Nevertheless, given existing consensus over core knowledge in physics, framing is expected to be relatively strong regarding the selection and organisation of knowledge especially in undergraduate education, as Becher (1990) and Kehm and Eckhardt (2009) show. In graduate education it occurs less (Kehm and Alesi, 2010). This study also hopes to reveal whether a weaker framing applies to master degrees, characterised by specialisation and pronounced research orientation, both giving more control to students over their studies. Culturally-conditioned settings in the countries included in this research are anticipated to have a bearing on the strength of the framing.

Drawing upon previous work by Biglan (1973), Becher and Trowler (2001) introduce a disciplinary classification framework built around two dimensions. The first one, distinguishing between hard and soft disciplines, refers to the degree of consensus around epistemologies and methodologies determined by the nature of disciplinary paradigms:

> Clear and unambiguous paradigms denote disciplinary consensus; competing, formless, or non-existent ones are ascribed to communities in which there is a significant level of internal disagreement in both general ways of seeing the world and specific ways of tackling research issues. (Becher & Trowler, 2001, p. 33)

The second dimension refers to the disciplinary focus: theoretical as opposed to practical knowledge application, i.e. pure versus applied.

Thus, the disciplinary typology proposed by Becher and Trowler comprises four categories: hard-pure, soft-pure, hard-applied and soft-applied. The authors claim that the epistemological properties of disciplines (the nature of knowledge areas portrayed as territories) and the socio-cultural features of the communities inhabiting them (the tribes) are organically intertwined:

> We argue that the ways in which academics engage with their subject matter, and the narratives they develop about this, are important structural factors in

> the formulation of disciplinary cultures. Together they represent features that lend coherence and relative permanence to academics' social practices, values and attitudes across time and places. Both disciplinary epistemology, understood as the 'actual' form and focus of knowledge within a discipline, and the phenomenology of that knowledge, the ideas and understandings that practitioners have about their discipline (and others), are important here. (Becher & Trowler, 2001, p. 23)

In the above classification physics is a hard-pure discipline. Starting from Becher and Trowler's characterisation of disciplines, but also drawing extensively on other sources, the next sections address the epistemological and socio-cultural attributes applicable to physics. Reference is occasionally made to soft disciplines to illuminate the contrasts between hard and soft areas. Wherever pertinent, implications for teaching and learning are highlighted. For ease of reference these are summarised in the last section of this chapter and will be considered in the analysis of Physics MSc degrees.

4.2.2 Physics as an epistemological territory

Becher and Trowler's description of hard-pure areas (2001) is a helpful point of departure to explore the salient epistemological properties of physics:

> cumulative; atomistic (crystalline/tree-like); concerned with universals, quantities, simplification; impersonal, value-free; clear criteria for knowledge verification and obsolence; consensus over significant questions to address, now and in the future; results in discovery/explanation. (Becher & Trowler, 2001, p. 36)

The first attributes 'cumulative; atomistic', 'concerned with universals, quantities, simplification', 'impersonal, value-free' denote a vast disciplinary area preoccupied with hard facts, logic and objectivity. Its cumulative nature suggests that new knowledge acquisition and production builds on already existing knowledge, the field growing by 'accretion' (Lattuca & Stark, 1994), whereas its atomistic property implies multiple concepts constructing the field. Lattuca and Stark describe how this shapes student learning and curriculum content, as opposed to soft areas:

> When scholars build a knowledge base systematically, they find curricular coherence easy to describe; the student is helped to place building blocks of the discipline, one upon another, until some prescribed level of understanding is reached. The softer fields acquire knowledge more often by recursive patterns of research than by systematic accretion. These iterative research strategies use multiple perspectives and pursue knowledge in several directions simultaneously, leaving room for curricular diversity. (Lattuca & Stark, 1994, p. 419)

These characteristics point to a huge body of knowledge whose mastery is a challenge, taking years to assimilate – hence the concern with knowledge acquisition observed by Smart and Ethington (1995) in pure fields. This is compounded by mastery of mathematics, a sine-qua-non condition for the application of physical concepts and laws. The vastness of physics knowledge explain probably two pedagogical manifestations: first, the concern with knowledge rather than skills and the tension between the two (Jones, 2009a) and, second, the 'all-or-none learning pattern' and tightly-structured courses with highly related concepts and principles observed by Donald (1983) in her analysis of course content in various disciplines. By drawing concept trees, she noted that for physics these were hierarchical, with branches from more to less important concepts, whereas in social sciences these were webs or clusters of concepts linked to a pivot one:

> These differing formats in the different subject matter areas suggest different learning patterns. In the sciences, key concepts appear to be tightly structured with more links between them, which would support an all-or-none learning pattern. Courses in the social sciences, on the other hand, appear to be more loosely structured with certain key concepts acting as pivots or organisers for others; the student who recognised a pivot concept would have an important learning cue. (Donald, 1983, pp. 37-38)

Becher and Trowler's next set of characteristics – 'clear criteria for knowledge verification and obsolence' – is supported by an observation of a physics lecture emphasising 'the need to verify the correctness of every procedure with basic mathematical and physical principles and the need to thoroughly understand why procedures work' (Hativa, 1995, p. 25). This probably explains the emphasis on problem-solving skills in physics (Jones, 2009a, 2009b). Although, as mentioned previously, a tension is manifest between knowledge and skills in physics, this does not apply to problem-solving skills. On the contrary, in a study aiming to reveal how the teaching of some generic attributes (critical thinking, problem-solving and communication) is shaped by disciplinary epistemology, Jones (Jones, 2009a, 2009b) notes the centrality of problem-solving in physics and its close relationship with content knowledge. Problem-solving is understood as 'hypothesis development and testing; use of mathematical modelling to describe and analyse the physical world; and the awareness of issues of precision and rigour' (Jones, 2009a, p. 181). Jones argues that problem-solving in physics is influenced 'by the need for abstract modelling and the use of mathematics as a means of analysis, (...) by experimental techniques and conventions, as by an in-depth understanding of theoretical physics', requiring an 'almost 'second nature' understanding of the knowledge base in order for the problem-solver to make connections, or to consider what might work or be reasonable' (Jones, 2009b, p. 90). The development of problem-solving skills is integrated in teaching and students get opportunities for practice in classroom and laboratory work.

However, the other side of the coin is the lower emphasis on critical thinking and communication – here a tension becomes apparent. Jones argues that whereas these skills are fundamental in soft areas of knowledge, they are regarded with ambivalence by physicists and perceived as a challenge to teach, especially at undergraduate level (Jones, 2009a). Students find difficulty in adopting a critical stance in a field supposed to have 'clear criteria for knowledge verification'. Nonetheless, this does not mean that uncertainty has no place in physics. Indeed, as Jones (2009b) points out, few physicists nowadays embrace a positivist paradigm, recognising that evidence can only support theories and not provide definitive answers and absolute truths. However, this realisation does not occur with undergraduate students, too busy to assimilate a vast body of knowledge. It is only at postgraduate level, once they start undertaking research, that students face uncertainties and start developing critical thinking. Hence the long period of maturation needed to become a physicist (Becher, 1990; Jones, 2009a).

Another telling characteristic identified by Becher and Trowler is 'consensus over significant questions to address, now and in the future'. This echoes Bernstein's concept of strong classification and the powerful sense of shared identity. Becher (1990) describes the corpus of physics knowledge as 'universal: what counts as a valid finding is not dependent on geographical and cultural considerations, and the process of establishing or refuting a claim knows no frontiers' (Becher, 1990, p. 3).

Kekäle also talks about physics as ‘an international science – there is no national physics. Methods, standards and procedures of physics are reasonably similar everywhere and similar results can be reached in every laboratory’ (Kekäle, 1999, pp. 230-231).

Identifying physics as the discipline enjoying the highest level of convergence, Becher and Trowler (2001) point to the reputation and power benefits derived from consensus. High levels of convergence give disciplines political influence, as they can speak with one voice to defend their interests. They also enjoy high status among the other disciplines and the general public:

> they tend to command the respect, admiration and envy of divergent disciplinary communities, and thus to be identified as members of the academic elite (...) they are further liable to be regarded by viewers outside the academic world as having privileged status (...) Conversely, disciplines at the opposite end of the convergent-divergent spectrum are seen internally as politically weak and externally as lacking in good intellectual standing. (Becher & Trowler, 2001, p. 192)

So far the analysis has focused on the cumulative and atomistic nature of physics and the subsequent focus on knowledge; the clarity of knowledge verification criteria and implications for the teaching of skills; and the consensus over core physics knowledge with consequences on curricular coherence. Lattuca and Stark (1994) summarise the interplay between these features:

> Fields such as science and mathematics, typically hard and pure fields where a common paradigm is acknowledged, are adept at discussing curriculum coherence but find the idea of critical perspectives to be unfamiliar, if not uncomfortable. Fields such as those usually classified as humanities, typically soft, pure fields, show reverse patterns: helping students develop critical perspectives is their forte, but acceptance of multiple paradigms seems to be associated with reluctance to describe and define coherence.’ (Lattuca & Stark, 1994, p. 407)

Returning briefly to my choice of discipline, curricular coherence has been a major reason behind preferring physics to economics. The selection of a soft discipline would have required attention to curricular diversity issues, partly diverting the focus from learning and teaching.

Strong research orientation and tight research organisation are other defining features of physics (Becher, 1990; Becher, Henkel, & Kogan, 1994; Smeby, 1996, 1998, 2000). Findings such as physicists' perception that supervision counts as research rather than teaching, time spent on supervision, strong identification with research rather than teaching, high publication rates etc. corroborate this. Moses (1990), Smeby (1996) and Becher and Trowler (2001) report, for instance, that whereas in the arts supervision is commonly subsumed under teaching, in hard sciences it is integral to research, since students' work makes a direct contribution to the department's research effort. This influences the amount of time spent on research supervision, which in a study by Smeby (2000) at the University of Oslo fluctuated significantly between 42 hours per year in the humanities and social sciences in contrast to 82 hours per year in the sciences.

Variation in supervision time is also associated to earlier discussions about core knowledge and paradigm strengths. Soft areas characterised by divergent paradigms and interests comprise numerous distinct areas and topics, giving research students plenty of options to choose from. It is thus less likely their research will be related to the supervisor's area of expertise, explaining why loose supervision is the norm. In contrast, in natural sciences where an 'all-or-none learning pattern" is common, students are often given research topics directly associated with the supervisor's specialism (Becher, 1990; Smeby, 1998):

> Postgraduates in physics, unlike those in a number of other disciplines, are not in a position to identify their own research topics because they lack the necessary contextual knowledge. They do, of course, have to select their research field and hence their supervisor, but the latter will normally make the choice of specialist topic for them. (Becher, 1990, p. 3)

In hard areas it is common for students to work in a team alongside other students and staff members all undertaking similar research, students' work becoming an essential part of the common effort. In fact, Smeby (1998) also reports physics academics' belief that it would be difficult to do research without graduate students. He thus speaks of the mutual dependency in the relationship between staff and research students (including master students) beneficial for both parties: students get involved in real research, and staff have a genuine interest in the topic and progress, as results will contribute to their own research. In the words of a physics academic:

> For us students are a resource; they make a positive contribution. They take part, solve problems and do a lot of hard work. (Smeby, 2000, p. 59)

Hermanowicz (2006) also highlights preoccupation with research, reporting that qualities physicists consider essential for career success invariably make reference to research. Research thus appears as the defining component of a physicist's career which can make the difference between success and failure. Hermanowicz mentions persistence as a quality of utmost importance, physicists having to deal with rejection throughout their careers since peer-reviews of papers and grant proposals, and experimental and theoretical work do not always yield results. Smartness and civility come second, understood as collegiality that helps form a work environment conducive to productive research. He also quotes persistence and ruthlessness:

> ...unfortunately one has to be ruthless as far as picking time to work on things. It takes long hours to get things done. Unfortunately, one has to be ruthless about publishing. The people whose names you know are well known because when a new idea comes out, they are quick about writing a paper on it. Even if it's half-baked. (Hermanowicz, 2006, p. 143)

This section has focused on the epistemological properties of physics as a disciplinary 'territory'. I now turn to the socio-cultural features of the 'tribes' who populate it.

4.2.3 Sociological characteristics of the Physics community

The people-to-problem ratio and the urban character of physics (Becher & Trowler, 2001, pp. 106-108) probably explain the above 'ruthlessness'. Making an analogy with ways of life, Becher and Trowler classify disciplines into urban and rural, the former being narrow areas of study clustered around a few prominent topics, and the latter 'a broad stretch of intellectual territory' spreading out across a variety of themes, with ill-defined problems. The urban/rural division corresponds broadly to the hard-pure versus all the other disciplinary typologies. However, the authors designate physics as the only entirely urban discipline in their study.

Urban disciplines are characterised by intense competition, hence the fear of plagiarism, the tendency to secrecy and the concern with speedy publication (Becher, 1990; Becher & Trowler, 2001; Hermanowicz, 2006). As the areas of study are narrow, with several people involved in the same issue, team-work and collaboration (also noted earlier in relation to research students) are the norm, as opposed to soft rural areas displaying rather individual endeavours in settings where interest overlap is not an issue. Because of shared professional concerns, urban 'gossip' tends to be professional, rather than 'personal dissection' and rumour common in rural areas.

Becher's portrayal of physicists (1990) corroborates this description. He describes physicists as a gregarious community, noting that it is unusual to encounter solitary characters. They value discussions with colleagues to keep informed of latest developments and to test ideas - physics thus becomes a social activity. However, Becher also remarks that the tendency to 'talk shop' separates insiders from outsiders, physicists drawing a circle around them. Networking, the common circulation of articles before publication and frequent participation in conferences are manifestations of the vital interaction with colleagues and the urge to keep up-to-date.

Becher also reports an unconditional commitment to physics and deep personal involvement. He quotes a respondent saying that some people 'see everything from a physics point of view, 24 hours a day' (Becher, 1990, p. 3) illustrating the difficulty to draw a line between work and private life. A physics professor quoted by Kekäle (1999) reinforces this finding:

> I have wondered that our students, only our good students have this feature... they are interested only in their own subject... they love physics, they do not see the world around them, and they do not value fields and research which is based on opinions. (Kekäle, 1999, p. 231).

Kekäle hypothesises that passion for their work explains physicists' preference for a well-working, straight-forward leadership style and pragmatic, less critical approaches. He also believes that the convergence characterising the discipline explains this relaxed attitude:

> If there is nothing to complain about – and the threshold of complaint seems to be quite high – they prefer to concentrate on their work, where shared methods and standards of the discipline reduce the possibility of conflicts, and where most problems can be solved empirically. (Kekäle, 1999, p. 232)

The sports metaphors employed by Kekäle are suggestive of the sociological properties of hard and soft disciplines – in the case of physics, collective concerns and collaboration. He likens physics – a hard, urban and convergent field – with fast team sports, with researchers working as a team competing intensely against other teams. Soft rural fields, such as history, are like jogging: people participate on their own or in small groups, the speed is low, the distance between start and finish is relatively long, with many interesting paths to follow, so participants might not stay on the same track and reach the same destination (Kekäle, 1999, pp. 233-234).

4.2.4 Physics learning and teaching

Neumann (2001) remarks that pedagogic research has focused largely on generic aspects, the role of disciplines in shaping teaching and learning receiving little attention. She thus recommends an extension of Becher’s study of academic tribes and territories into teaching and learning. In attempting to locate literature on physics learning and teaching, I was also confronted with a scarcity of research. I next present a summary of the implications for learning and teaching in physics identified in the previous sections and complement these with findings of recent research undertaken in the context of the Bologna Process (Kehm & Alesi, 2010; Kehm & Eckhardt, 2009).

The agreement over core knowledge is reflected in curricular coherence and the discipline transcending frontiers. Consequently, undergraduate curricula are similar in different countries, as testified by Kehm and Eckhardt’s study (2009) of the implementation of Bologna reforms into physics bachelor programmes in Europe:

> There is a clear indication that the first two years of a Bachelor programme in Physics tend to be rather similar everywhere, because students have to be familiarised with the tools of the trade and the subject matter of the discipline. The third year of the programme (...) is typically used for project work giving the opportunity for a certain degree of specialisation. (Kehm & Eckhardt, 2009, p. 18)

However, curricular coherence does not characterise master programmes (Kehm & Alesi, 2010). Therefore, in order to facilitate comparison, the programmes chosen in this research are generic MSc programmes rather than specialised ones (e.g. Medical Physics, Nanoscience etc.).

The many interdependent concepts and laws building a huge body of physics knowledge determine a highly-structured curriculum organisation and the “all-or-none learning pattern” (Donald, 1983). This could explain the cognitive concerns and the emphasis on knowledge rather than skills. The one notable exception are problem-solving skills perceived as essential for a physicist, hence part and parcel of physics teaching. On the contrary, critical thinking and communication, deemed essential attributes in soft areas, appear to pose problems in undergraduate teaching. Critical thinking in particular emerges as difficult to teach given the misleading perception early on that physics deals with certainties and universal laws. However, this perception is prone to change once students embark on postgraduate education. As to other skills, Kehm & Eckhardt’s study reveals that a large proportion of respondents (78%) stated that acquisition of transferable skills is considered in their physics bachelor programme. The most commonly mentioned were English language skills (in non-English speaking countries), communication skills and project management skills. Kehm & Eckhardt also report on the tendency to ‘outsource’ these to other departments or centres supporting teaching and learning (Kehm & Eckhardt, 2009, p. 16). I also aim to explore whether the compared MSc degrees give weight to knowledge and/or skills (or both) and how they approach skills teaching.

The emphasis on knowledge and/or skills also influences assessment. Braxton (1995) distinguishes between assessment based on memorisation and application of course material in hard sciences, as opposed to assessment requiring analysis, synthesis of course content and critical thinking. Hard fields prefer reports, whereas oral examinations are employed in the humanities. Neumann (2001) also notes that whereas hard sciences give more weight to examinations, soft areas show a tendency towards continuous assessment. However, Kehm & Eckhardt (2009) and Kehm & Alesi (2010) have observed a remarkable change in the majority of continental European countries: a shift towards continuous assessment and a reduced emphasis on final examinations. A majority of respondents also reported that in addition to knowledge they also assessed transferable skills (60% in bachelor and 56% in master programmes). It will be interesting to see whether my findings about assessment in physics MSc degrees mirror these findings.

I already mentioned the strong research preoccupation in physics. I discussed how physics academics consider research students as valuable members of research teams and thus integrate them in the department's research effort. In hard areas, research supervision follows 'a group-based apprenticeship model', a necessary component of socialisation into the discipline (Neumann, 2001). I thus expect the focus on research and on training students to become researchers to transpire quite strongly in the chosen MSc programmes.

Kehm and Eckhardt conclude that while structural convergence of programmes is expected to continue, the 'shop floor' level will display 'a considerable amount of diversity and heterogeneity' reflecting differences in national academic cultures and teaching and learning styles (Kehm & Eckhardt, 2009, p. 19). This research aims to compare and contrast such differences and continuities through the lens of academic and student conceptions of master degrees and their translation into learning and teaching practices.

Chapter 5 Reception of the Bologna Process

The epistemological underpinnings outlined in Chapter 2 – sociocultural theory and cultural interpretation theory – propose connections between meaning, action and context. The context (institutional, national, cultural, etc) is a unique space determining the emergence of particular meanings about the world and its phenomena. An insight into the meanings sheds light onto the practices of actors faring in these contexts. Thus, the reception of the Bologna Process in different national and institutional settings is expected to have been shaped by the meanings assigned to this European-wide initiative by the actors who populate them. Understandings of Bologna therefore influence action, i.e. the take-up and implementation of its action lines, of which the second cycle (the master degree) is the particular concern here.

This comparative analysis thus considers three dimensions mindful of both meaning and action: views of the Bologna Process and responses to it; conceptions of the master degree; and learning and teaching practices in master programmes. These dimensions will be analysed in turn in political and institutional settings in England[4], Portugal and Denmark.

The first concern of this research is the views held about Bologna by representatives of national organisations with a stake in the Process and by academics teaching on master programmes. The interviews with national representatives and policy documents (legislation, reports, position papers etc.) indicate different degrees of importance attached to Bologna in the national policy agendas and different understandings of the process shaped by unique national circumstances. The academics' views, too, are coloured by national and context-specific features. The influence of physics as their discipline is probably less evident here than in the case of master degree conceptualisations and learning and teaching.

Before discussing the three national contexts, a brief overview of the Bologna Process and its policy mechanisms will be presented.

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[4] Sometimes the UK (or Britain) rather than England will be referred to, as some of the stakeholder bodies mentioned in this thesis have a UK wide-remit, and some political initiatives or trends are representative of the UK as a whole, and not just England. However, wherever possible and applicable, the focus will be kept on England.

5.1 Policy-making in the Bologna Process

The Bologna Process was officially initiated in 1999 when the HE ministers of 29 European countries signed the Bologna Agreement (preceded by the 1998 Sorbonne Declaration signed by the French, English, German and Italian ministers). Having as ultimate aim the establishment of the EHEA by 2010 through the convergence of European HE systems, the Process gained considerable momentum with more and more adhering countries and more and more action lines added to the six initial objectives (readable and comparable degrees; a system based on two main cycles, undergraduate and postgraduate; a system of credits; mobility; European cooperation in quality assurance; European dimension in HE).

Despite having triggered considerable changes in national HE systems, Bologna policy-making and implementation is steered by soft law expressed in the open method of coordination (OMC). Contrary to misperceptions, the Bologna agreement is not legally-binding and, therefore, does not require compliance. Nonetheless, the declarations and communiqués seem to have a ‘quasi-legal’ value, giving the Process an appearance of ‘juridicity’ (Ravinet, 2008). The reasons for its success are thus worth exploring, as they help explain the variations in implementation among different countries.

Ravinet (2008) offers some explanations about the development of the sense of obligation. The Bologna rhetoric and the weight of the ‘knowledge society and economy’ concept assign higher education a new role, crucial to countries’ international competitiveness. It therefore needs reforming to be more effective, implementation appearing a reasonable way to act. Moreover, the development of a monitoring and coordination mechanism with increasingly standardised tools and procedures has created pressure on countries to act. For each biennial ministerial conference, national reports, stocktaking reports and colour-coded scorecards are prepared. Based on common templates, these reports and scorecards allow at-a-glance benchmarking, comparisons and easy identification of champions and laggards in the implementation of the Process, acting as an efficient ‘naming and shaming mechanism’ and creating effects of ‘socialisation, imitation and shame’ (Ravinet, 2008). Bologna policy-making thus relies on information, or sermons, (Vedung, 1998) to trigger implementation.

Similarly, Neave & Amaral (2008) refer to a "strategy of competitive emulation" to lever reform, applied to the relationship between different national HE systems seen as symbols for national standing, efficiency or social responsibility. They compare it to socialist competition advocating better rationalisation of work to increase productivity and involving suasion, conditionality and incentives:

> Whether applied to the coal hewn per miner per shift in the Donetz basin or to aligning study programmes upon the 'architecture' of Bachelor and Masters degrees in the case of institutes of higher education, moral suasion, shaming, and the implicit threat of backsliding or non-compliance bring such pressure to bear that exceptional performance by the few becomes the expected norm for the many. (Neave & Amaral, 2008, p. 43)

Bologna has also opted for a broad-front approach and an image of rapid success, crucial to push forward further progress (Neave & Amaral, 2008). Success was initially demonstrated by the capacity of member states to enact Bologna through legislation. However, this is hardly synonymous with progress. As Veiga et al (2008) show, the picture presented by stocktaking reports, and in the political arena, is often overoptimistic, since the actual implementation at institutional level is not always achieved in substance. Chapters 6 and 7 in this study will explore this dichotomy.

Against national and institutional idiosyncrasies, priorities and constraints, the adoption of the OMC to drive forward implementation, despite bringing transformation in national HE sectors, can hardly guarantee convergence (Veiga & Amaral, 2006). Due to the subsidiarity principle applicable to HE, national governments maintain decision-making power over reforms to pursue. Neave & Amaral speak of the 'hidden face' of Bologna and the manipulation of its objectives by governments to enact unpopular reforms, describing it as 'a heaven-sent opportunity to gain new purchase over domestic issues that, earlier, tended to be delicate in the extreme' (Neave & Amaral, 2008, p. 44). Implementation is afterwards open to the interpretation of individual institutions, making convergence increasingly diluted. In this respect, Wächter (2004) suggests that a transparency and convertibility approach, rather than a convergence approach, should be better suited to describe the Bologna Process.

5.2 England

5.2.1 National/Political reception

In England the Bologna Process came as a low-impact development in the national landscape. It passed largely unnoticed in the first years, however later on it was acknowledged, albeit as a low priority on the political agenda. Engagement with the Process appears to have been reactive rather than proactive, further to concerns that started to emerge about specific issues (quality assurance, second cycle, ECTS) threatening to evolve in undesired directions. Referring to this stance, Sweeney (2010) states:

> ...the UK has been a reluctant partner adopting stances that range from the defensive to the dismissive, even at times aggressive. The UK has been anxious to demonstrate compliance, but it is difficult to identify enthusiasm or commitment. The key objective seems to have been to ensure that UK interests and ways of doing things are safeguarded. (Sweeney, 2010, p. 8)

One reason invoked for the English detachment is the belief that the Bologna recommendations broadly took the Anglo-Saxon organisation of studies as a reference (the cycle system, quality assurance, etc.) - hence the view that the English HE system was already ahead in the game, in a position to which other countries aspired. This highlights the perception of Bologna as a structural reform, at the same time explaining the lack of imperatives to take action in the early days of the Process. Therefore, some research participants accuse England of complacency:

> I'd use the word complacent. As you encourage me to speak honestly, I think the principal reforms that Bologna has been pursuing for the last decade or so around the structure of the three cycles, the move to increasing mobility, the move to credit frameworks, in a large respect I think the UK thought it was already there, particularly around the three cycles. So Bologna wasn't something they needed to respond to particularly quickly or particularly in depth. (Peter Baldwinson, BIS)

> I think that as much as anything else it was just this feeling that everyone is coming around to our way, so why should we bother to change anything? (Peter Main, IoP)

As a result, whereas other signatory countries embraced Bologna as a lever for system-wide restructuring, in England it did not appear as an opportunity for necessary radical reforms in higher education – hence the passive attitude of the English:

> Certainly actually if you look at the build-up to the Sorbonne Declaration, in France, Germany and Italy, in all three countries there were major reports looking into the higher education systems, and they had tried to reform the systems themselves, but needed that external driver to be able to push through the reform. In a sense the UK didn't need to do the same fundamental reforms and therefore didn't need the external branding of the Bologna Process to be able to force it through. (Alex Bols, NUS)

Although a Bologna-driven restructuring appeared unnecessary, English HE has nonetheless been subject to reforms addressing other stringent concerns (i.e. the introduction of tuition fees). These priorities, driven by national rather than European imperatives, have captured the political attention and impacted institutions significantly. They have obscured the Bologna Process on the government's agenda and resulted in no-action, as the Department for Business, Innovation and Skills representative declares:

> I think it would be unrealistic to think that the Department and ministers would want to get into that kind of a more hands-on role when it comes to Bologna, because I think it's fair to say that in the large scale of things Bologna, as far as ministers and the Department are concerned, is not in the top 20 of issues affecting UK higher education as we speak today. There are lots of more fundamental and important issues that the UK higher education system will be grappling with in the next year or two. (Peter Baldwinson, BIS)

Political documents reveal HE priorities in the past decade mainly related to the economic function of universities, widening participation and funding. Both the 2003 White Paper *The Future of Higher Education* (Department for Education and Skills, 2003) and the 2009 government strategy paper *Higher Ambitions – The future of universities in a knowledge economy* (Department for Business Innovation & Skills, 2009*)* praise the success and privileged position of British HE. Nonetheless, they warn against resting on laurels, highlighting the need for forward-planning in the face of challenges like stringent economic circumstances, demographical trends, international competition, increasing importance of knowledge for the economy etc.

The two government papers as well as the new Conservative-Liberal Democrat coalition programme, *The Coalition: Our plan for government* (HM Government, 2010) depict similar visions for higher education:

- universities as major contributors to the economy (collaboration with businesses, labour-market relevant foundation degrees, prioritisation of STEM areas for economic growth, research commercialisation and knowledge exchange)
- widening access (short two-year degrees, foundation degrees, flexible delivery – part-time or work-based)
- sector diversity and institutional missions capitalising on different strengths (i.e. teaching, research or engagement with the community)
- new funding regime to diversify universities' income sources, specifically greater reliance on tuition fees.

It is probably the first-time introduction of variable fees in 2006, and their later revisiting by the Browne review in 2009-10, that has received most attention in the past decade. Further to the report *Securing a sustainable future for higher education in England* (Browne, 2010) new reforms of higher education finance have raised the tuition fee cap for new university entrants from 2012.

It is maybe significant to note that none of these high-level government papers mention the Bologna Process, not even in relation to the international dimension of higher education. They focus on overseas promotion of universities, the creation of partnerships and the recruitment of overseas students paying full fees, thus representing an essential source of funding. The Government's role is to 'help communicate a strong 'UK Higher Education brand', and align it with its cultural and diplomatic agenda'. The attention to overseas markets is also evident on the Department's website whose section on international education refers to India, China, Middle East and North Africa and Sub-Saharan Africa[5].

[5] http://www.bis.gov.uk/policies/higher-education/international-education (accessed 13 September 2011)

Another reason for low engagement is scepticism about Bologna elements not featuring in the English system, or those 'not invented here' in the words of one interviewee. Such is the case, for instance, with ECTS or the emerging 3+2 structure:

> Some things, I think the sector regarded, if not with suspicion, certainly wanting to be persuaded of the benefits of it, for example the ECTS framework; it took the UK I think a while to get round to developing its own credit framework, of course it's not using the ECTS[6], which again I think sends the wrong signal that the UK is not fully committed at the institutional level to some of the Bologna Process reforms (…) I would say it was in some respects a bit complacent... some of the things that are coming out of Bologna, not invented here, so we're going to do it in a slightly different way in the UK. (Peter Baldwinson, BIS)

Participants' accounts suggest it was only around 2004 that England started to pay attention to Bologna. This is reflected in a Europe Unit note (Europe Unit, 2004a) advising engagement in order for the UK to influence discussions on a European QA system and ECTS and avoid being cast in a negative light. A parliamentary inquiry into the Bologna Process also seems to have been conducted further to growing concerns. The inquiry report (House of Commons Education and Skills Committee, 2007a) highlights similar reasons why the UK cannot afford to be complacent and detached, again related to potential dangers resulting from European HE evolving in directions which could endanger the UK's competitive advantage:

> ...if comparability and compatibility of higher education develops apace across the EHEA without efforts from the UK to keep up, it could result in reduced competitive advantage for the UK. This could be a particular problem if the UK has not taken steps to ensure that its qualifications are recognised within this broader area. This risk is exacerbated by the recent growth of courses across mainland Europe taught in the English Language. (House of Commons Education and Skills Committee, 2007a, p. 25)

Concerns about the evolution of the Bologna Process transpire from several documents: the above report, UK position statements prepared for ministerial summits and Europe Unit notes. Several fears emerge. First, the Bologna aim of

[6] Institutional autonomy allows HEIs to choose whether or not to adopt ECTS. It is not regulated nationally.

comparability might evolve towards ‘a more typical European-style bureaucratic, top-down, rigid and legislative process which would result in higher education sectors being forced to move towards standardized or uniform higher education systems’ (House of Commons Education and Skills Committee, 2007a, p. 15). This leads to a further perceived danger: threatened institutional autonomy, considered as one of the strengths of UK HE (Department for Business Innovation & Skills, 2009; House of Commons Education and Skills Committee, 2007a).The preservation of institutional autonomy is a constant appeal in all UK position statements to Bologna summits (Europe Unit, 2005, 2007, 2009) and invoked as a cause worth pursuing across Europe:

> The UK and Ireland are currently the only countries in the EHEA with flexible, autonomous higher education sectors. There is a very different culture across the rest of continental Europe where state-owned higher education systems are closely controlled by government through detailed legislation outlining degree structures, financial arrangements, credit systems, and even curriculum. A key part of the modernization process will be moving towards a system that allows and encourages more flexibility and autonomy in higher education institutions across the EHEA (House of Commons Education and Skills Committee, 2007a, p. 22).

Second, there are fears that the European Commission (EC) might highjack Bologna to pursue centralisation (Europe Unit, 2004a, 2005, 2007; House of Commons Education and Skills Committee, 2007a). Emphasising inter-governmental decision-making, the UK warns against EC intervention which could undermine institutional autonomy and national sovereignty over HE. This is illustrated by the UK’s opposition to the establishment of a European register of quality assurance agencies. According to the parliamentary inquiry, EC interference in higher education would lead to a bureaucratic and rigid regime stifling creativity:

> …we have been made aware of disquiet about how the future development of the Bologna Process might impact upon the autonomy of UK universities. In particular, worries have been expressed in written and oral evidence that the role played by the European Commission might be contrary to the principles that inspire Bologna in that it may increase bureaucracy, centralise control and encourage conformity, whilst diminishing flexibility, responsiveness and

> creativity. (House of Commons Education and Skills Committee, 2007a, p. 32)

Despite official documents telling a story of active engagement (Europe Unit, 2005, 2009) interviews report complacency, as mentioned earlier. The government's no-intervention position has had a two-fold effect. First, paying little attention to Bologna resulted in low awareness of the Process in English HEIs. Acknowledging this is still the case, the UK Europe Unit representative points nevertheless to a surge in awareness, evident in an increasing use of the diploma supplement and ECTS. However, the National Union of Students representative claims that understanding is superficial even in the political arena:

> …essentially it's not known at all, even at the policy level if people have heard of it, it would have only been in passing and they won't know the detail of it' (Alex Bols, NUS).

Second and probably with more serious consequences, the passive English attitude – 'sitting on the sidelines' according to one interviewee – has led to an undesired effect. Initial understandings of Bologna elements (believed to be based on the Anglo-Saxon tradition) have sometimes evolved in unexpected directions capable of singling out England, such as for example the structure of the second cycle. In hindsight, had the English engaged more with Bologna they would have been able to influence the development of understandings. This echoes the rationale for engagement invoked in official documents:

> ...whilst when the Declaration was signed in '99 England knew what we meant by the various terms, what's happened over the last ten years is that either individual European countries or the Process as a whole have started to come up with their own definitions of what they mean (...) increasingly there are Bologna definitions of issues and that isn't necessarily the England definition. And so almost by having stood on the outside and not been actively engaged in those, we've missed a certain amount of opportunity to actually shape how these ideas, which may initially have been based on the English system, how they've now been interpreted, how they've actually been implemented in the countries. (Alex Bols)

England’s engagement with Bologna thus appears to have been driven by a desire to influence the evolution of the Process in favourable directions. In terms of actual reform, it has been walking a different path from continental European countries perceived to have pursued far-ranging national reforms backed by European drivers. England, in contrast, has pursued priorities independent of Bologna and finding little resonance in it. One much debated outcome of these different positions has been the emergence of the 3+2 structure in Europe and the maintenance of the 3+1 structure in England, opening the controversy around the one-year master.

The reform agendas thus appear divergent, despite a number of shared priorities such as Bologna’s lifelong learning agenda and English emphasis on widening access to HE, or the Bologna objective on the attractiveness of European HE and England’s interest in preserving its international reputation. It could be that the nature of Europe-wide reforms, i.e. structural, has not found an echo in England, and that English interests only coincide with later Bologna aims which can only be pursued once structural reforms have taken place. The words of the QAA representative regarding Bologna are telling about the extent of overlap between English and European interests:

> …we probably can’t answer your questions in as much depth as maybe overseas agencies because it’s not at the heart of our remit. Some of your questions don’t resonate with us because we haven’t looked at those things or we’ve not been asked to look at them. (Laura Bellingham, QAA)

Several accounts highlight that no authority has assumed ownership and leadership in promoting Bologna in England, possibly another reflection of the remoteness of the Process from English concerns. The Ministry and QAA representatives, however, invoke the constitutional arrangements applying to UK HE and the cherished institutional autonomy to explain why they have not taken an active lead in promoting Bologna:

> The Department doesn’t wield the same level of power or have access to the same robust set of levers to influence institutional behaviour that may apply in other countries. So I think the ministerial view is because Bologna is an intergovernmental agreement and it’s for institutions to take on board the reforms in their own way, at their own pace, this is a sectoral issue as far as implementation is concerned. (Peter Baldwinson, BIS)

> … we cannot take control in the UK, it's not like a body like ours can go out and tell universities what they should be doing, they're autonomous and independent, they're responsible for their own degrees. Although we publish frameworks, that's a reference point, it's not legislative (…) we saw that when we went to consultation on the masters piece of work people were asking about Bologna and ironically what it is that they should be doing, even though I think we would be in a strange position if we tried to tell them what they should be doing (Laura Bellingham, QAA)

Therefore, the message is that given institutional autonomy it is up to HEIs and to representative bodies to take the initiative and implement the Bologna objectives in ways meaningful to them. The BIS representative believes there has been a plethora of information about Bologna, hence the sector should have no excuse not to know about it and not to engage. Nonetheless, these and other accounts also indicate an awareness that institutions did indeed feel the need for leadership on adequate responses to European developments. For instance, the UK Europe Unit is reported to have been established in 2004 in response to increased awareness and concern in the sector about the implications of the Bologna Process.

Thus, a mismatch of expectations regarding the nature of response to Bologna becomes evident, whether coordinated sector-wide or undertaken by individual institutions, whether top-down or bottom-up. National bodies expect universities to take the initiative, whereas universities appear to expect coordinated leadership on the way forward. The Institute of Physics representative summarises plainly this expectation mismatch and the lack of direction experienced by the physics constituency. Frustrated concerns in institutional circles exist alongside the low political priority attributed to the Process and the lack of ownership nationally:

> I think it's probably fair to say – and this is where the Kafka side of it comes in – that there was really no-one owning the Process. And so universities would come to us at the Institute and say 'Will someone come and tell us that we're not doing it properly?' about Bologna. And we'd say 'Well, no, because there isn't anyone'. And I think our largest criticism of what happened in the UK about Bologna is that no group – and there could have been many, it could have been HEFCE, it could have been UUK, it could have been the

> Government, it could have been QAA – none of those bodies took on any responsibility for owning the Bologna Process. (Peter Main, IoP)

5.2.2 Academic reception

Interviews with academics teaching on physics master degrees in both English institutions in the study reveal a view of Bologna as an initiative aimed at structural resemblance among European degrees. They use words like 'standardisation', 'equivalence' or 'harmonisation'.

However, doubt is evident in both institutions that alignment is possible between degrees in England and the rest of Europe because of the funding regime applicable to English postgraduate provision[7]. HEFCE prioritises funding for undergraduate rather than postgraduate taught degrees, assuming a higher fee income for the latter. Fees are therefore expected to be the main source of funding for postgraduate degrees, hence universities would have to rely on fees to fund an additional year on the master.

Concerned with the scarcity of HEFCE funding for postgraduate courses, respondents thus note a contradiction between the British government's expression of commitment to Bologna and the funding arrangements. HE authorities are accused of passivity, and both master programme coordinators express frustration at the difficulty of aligning the degree structure to the emerging European model:

> We have to work within the framework of what the UK higher education authority and also the UK higher education funding council tell us (...) I think we would presumably welcome if there was more of an effort at a UK wide higher education administrational level to show more initiative in complying and implementing the Bologna Process. (I2.1)

Nonetheless, in relation to the funding regime of integrated masters, the IoP representative draws attention to an inconsistency between the HEFCE definitions of

[7] Funding for teaching in English HEIs is allocated by the Higher Education Funding Council for England (HEFCE) as a block teaching grant based on total student numbers (counting UK and EU students only). However, HEFCE's calculations take into account an 'assumed resource' which includes tuition fees as a source of university income. For undergraduate students the assumed tuition fee income equals the basic fee amount institutions can charge (£1310), rather than the higher amounts allowed under the variable fee regime introduced in 2006. On the contrary, assumed fees for most postgraduate taught students amount to £3951, meaning that these students attract little or no funding (HEFCE, 2010, p. 26).

undergraduate and graduate degrees and the corresponding cycles in the qualifications framework. Integrated masters count as undergraduate programmes, attracting higher funding based on HEFCE's assumption of lower assumed resource from fees. However, the qualifications framework classifies them as second-cycle, thus corresponding to a postgraduate qualification. Thus, in theory universities could offer five-year integrated masters which would benefit from funding on account of their classification as undergraduate. According to the qualifications framework, however, they would be second-cycle, thus counting as postgraduate. There is thus inconsistency about what counts as under- or postgraduate:

> We clarified with HEFCE what the situation was, and in fact there is nothing to prevent universities from having a 3+2 integrated masters as an undergraduate course. So you can get undergraduate funding. Of course, the waters are mudded by what we mean by undergraduate and postgraduate. And again, QAA have been very careful about this and they don't refer to undergraduate masters, they refer to integrated masters, right? But it is a grey area because the integrated masters are funded as undergraduate courses for the four years, and indeed for the five years if anyone could be bothered to do it. (Peter Main, IoP)

In the new fee regime funding for an additional year appears even more problematic. If it were incorporated in a longer integrated master, the concern is that students would be deterred by another £9K of debt. In stand-alone masters with no guaranteed funding it becomes an even bigger problem.

Awareness of the Bologna Process is almost unanimous among academics. It is important to note though that Institution 2 already offers a two-year Euromasters alongside one-year and integrated masters, which will have contributed to staff knowledge about European trends in higher education, whereas Institution 1 is described by one interviewee as one of the most Bologna-aware institutions in Britain due to its international projection.

Academics in one university appear rather neutral to the Process, whereas in the other one they express embracing views. However, two lecturers do wonder whether openness derives from the composition of the academic body in this particular department, predominantly from other EU countries.

An aspect that comes out strongly in both institutions is the view that Bologna does not concern individual lecturers, or impacts on their work. There is a shared opinion that dealing with Bologna issues lies within the remit of people responsible for programme design and coordination. They are a layer acting as buffer and intermediary, decoding Bologna messages and disseminating them for staff. Both lecturers with purely academic duties, and those with specific responsibility for running the master degree express this view:

> I think there's an awareness of the Bologna Process, there's an awareness that we need to do something about it, but I think most staff are happy for the people in control to sort it out. So I don't think it actually impinges very much on individuals. But I think they are happy to know that things like the teaching committees and the departmental teaching people are making sure that what we do is appropriate. (I1.1)

This perception of Bologna – a policy one needs to be aware about, potentially requiring change, but nonetheless with no bearing on teachers' day-to-day practices – is noteworthy. Bologna is out there, it does not affect lay academics. It is the responsibility of people at higher levels to take action to ensure alignment – hence a perception of Bologna as bringing higher-level, maybe strategic changes, but none impinging on everyday work. There are also indications of the misperception that Bologna requires compliance:

> I think the fact of daily life as a lecturer you have many tasks to fill and Bologna is one of these other things. Our head of teaching and learning is, I'm sure, aware of it in detail and we interact basically with her to make sure that it's all aligned properly with it. (I2.4)

A tentative explanation of this irrelevance for lay academics is their understanding of Bologna as a purely structural reform requiring higher level decision-making to ensure degree alignment in the institution. Therefore it neither interests, nor is it an immediate responsibility for the individual academic.

In summary, Bologna entered the English political arena as a low-profile initiative. It was perceived as a structural reform with little relevance for English HE, hence the authorities' passive stance and subsequent accusations of complacency. Scepticism towards imported Bologna elements such as ECTS is noted, too. Justification for engagement with Bologna lies in England's interest to influence the evolution of the Process to prevent directions likely to prejudice English HE. Bologna appears thus more a threat than an opportunity, a perception also evident in England's concerns over the emergence of bureaucratic practices, the role of the EC and threats to institutional autonomy and national sovereignty. National agencies expect Bologna to be a grass-roots initiative, with universities taking the lead. Alongside the perceived low relevance of Bologna, this is likely to be one reason for no authority taking ownership.

The interviews with academics confirm the mismatch in expectations between the political and institutional fields. In institutions, there is an expectation of top-down steering to guide the implementation of the Bologna Process. Lecturers expect the next level up (teaching committees, staff responsible for programme design) to lead and take appropriate action, while this middle level feels helpless about the Government's lack of initiative. Overall there appears to be willingness to align to Bologna, but financial arrangements act as a deterrent. The academics involved in the two master degrees do not perceive Bologna as a sector-led process emerging bottom-up, as national representatives expect it to be in a context of institutional autonomy. This seems to result from a lack of resources to implement what they understand as Bologna degrees, as well as lack of relevance for lay academics.

5.3 Portugal

According to interviewed representatives of national Portuguese organisations responsible for HE and interviewed academics, Bologna seems to have enjoyed little attention at the beginning, only to be subsequently embraced both in the political sphere and in academic circles as an opportunity for modernisation, albeit apparently for different reasons: cultural and later economic for the political class, and pedagogic for academics.

5.3.1 National/Political reception

At national level, political instability and frequent changes of government in the early years made engagement with the Process problematic. Pedro Lourtie, involved in Bologna at its beginnings and later Secretary of State, describes the early years as having 'black-out periods'. Moreover, his testimony points to governmental scepticism:

> …between November 99 and July 2001 I had meetings with the minister and the secretary of state and they were ‘well, I don’t think we should apply that in Portugal’ and they were not very convinced. In fact the Minister of Education changed a lot because we had one minister from November 99 until I don’t know when, and then we had another minister until July 2001, another minister from July 2001 to April 2002... (Pedro Lourtie)

According to several accounts, the appointment of Maria Graça Carvalho as Science and Higher Education minister in 2003 marked the beginning of Bologna initiatives, i.e. Decree-Law 42/2005 introducing the use of ECTS and the Diploma Supplement (Ministério da Inovação Tecnologia e Ensino Superior, 2005). Working groups were created to look at the implementation of the Process in distinct subject areas, resulting in discussions and reports. Then, in 2005 with the appointment of José Mariano Gago as Minister of Science, Technology and Higher Education, Portugal started engaging with Bologna at an accelerated pace. The minister’s address to the National Education Council in 2007 identifies Bologna as a top national priority:

> Our first priority since 2005 has naturally been the implementation of the Bologna Process in Portugal and doing away with the delay we have experienced in this area (MCTES, 2007e).

A plethora of legislation followed, facilitating the adoption of Bologna action lines in Portugal. The first measure was an amendment to the Basic Law of the Education System in the form of Law 49/2005 (MCTES, 2005) stipulating three rather than four higher education qualifications. Then Decree-Law 74/2006 regulated the organisation of degrees according to the new three-cycle structure imposing the firm deadline of 2009/10.

High political commitment since 2005 is reflected in a proliferation of legislative measures (in addition to the above-mentioned ones). Some obviously pave the way for the implementation of the Bologna Process, whereas others (i.e. new legal framework for HEIs) appear less related:

- Decree-Law 64/2006 approving a new path to HE for students older than 23, not holding the standard requirements (MCTES, 2006a)

- Decree-Law 88/2006 regulating technological specialisation courses (CETs), first-cycle vocational programmes offered to students having completed or almost completed upper secondary education (MCTES, 2006c)
- Law 38/2007 establishing the legal framework for quality assurance (RJAES) (MCTES, 2007c)
- Law 62/2007 establishing the legal framework of HEIs (RJIES) (MCTES, 2007d)
- Decree-Law 341/2007 stipulating legal arrangements for foreign HE degrees recognition (MCTES, 2007a)
- Decree-Law 369/2007 establishing the Higher Education Evaluation and Accreditation Agency (MCTES, 2007b)
- Ministerial Order 30/2008 regulating the use of the Diploma Supplement (MCTES, 2008b)
- Decree-Law 107/2008 stipulating mechanisms for monitoring the Bologna Process and the transition from an educational system based on knowledge transmission to one based on student competences. (MCTES, 2008a).

At political level, engagement with Bologna thus materialised in the passing of legislation establishing and regulating structures and tools essential to the implementation of Bologna objectives such as degree framework, ECTS or diploma supplement, the quality assurance agency, lifelong learning etc. According to a ministerial note, the stocktaking exercise preceding the 2009 Bologna summit evaluated Portugal among the five countries to have best implemented the Process (MCTES, 2009b). This is probably a reflection of the intense legislative activity and the impression that Portugal was making great progress. The student representative's words convey the abundant changes:

> The university hasn't breathed, in Portugal we haven't breathed since 2005. There is one reform after another reform, after another reform, after another reform. So it's been beaten up continuously. (Bruno Carapinha)

In analysing drivers for embracing Bologna, a difference emerges between the opinions of interviewees politically involved in the early stages of the Process and those with current responsibility for HE policy. The former emphasise reasons related to the overhaul of European HE as a whole to reduce national differences, promote recognition, mobility, transparency, and thus increase its attractiveness in the world.

The student representative also shares this view. Reform was also needed in Portugal so that its aligned HE system would benefit from cross-border recognition and mobility:

> Europe needed to be more competitive. It meant that we needed to be more similar from country to country, it would be easier to be mobile in Europe, and in Portugal we had a problem because we had four degrees rather than three. So the equivalence, the recognition of our degrees in other systems was different, it was rather confusing (…) So there was this conviction that we should try to work more with each other, accept more the degrees from the different countries. (Pedro Lourtie)

> …there is this expectation that our system will be levelled up to the level of other systems operating in Europe, and that by emulating practices and schemes and ways of doing things we can renovate the kind of system that we have (…) And also mobility, I think mobility was another expectation and that never happened. (Bruno Carapinnha)

Motivations appear primarily cultural and educational, but also social, as the Bologna-triggered shortening of degrees is a way of expanding access to HE:

> Bologna is another thing, it's mass education. You must have a system which will allow you to have mass education, and you cannot have mass education with five-year degrees. (Sebastião Azevedo, BFUG)

The previously mentioned Minister's address from 2007 makes this explicit, too, stating in relation to Bologna that 'it is not only about guaranteeing recognition of the qualifications of the Portuguese in the European area, and their mobility, but especially about promoting equality of opportunity to higher education access, improving attendance and completion rates, attracting new publics, diversifying provision' (MCTES, 2007e).

The current government representative also portrays Bologna as an opportunity to modernise Portuguese HE, but the discourse relies this time on economic reasons and on linking higher education to economic and societal demands. Some initiatives are clearly linked to Bologna: the first cycle, now shorter, will attract new audiences to higher education; the second cycle is intended as a lifelong learning tool to allow people to train and retrain throughout their working lives; the overhaul of the accreditation system and the creation of the Agency for Higher Education Evaluation and Accreditation (A3ES) are linked to quality assurance. The following extract illustrates the view that higher education has an economic responsibility, mindful of market needs:

> We see the second cycle very important, if it is well done, to really implement a lifelong learning strategy for society at large so that people can come back to the institutions to re-qualify in different areas. Life is changing at a fast speed and everyone, almost everyone, ends up by doing things they were not initially trained for (…) And the difficult thing is to adapt the institutions to real market demand (...) Again we believe that the new governance law, by bringing people from outside the university to manage the university, will facilitate this change of culture because we know there is a large gap between what is the supply of some skills from the institutions and the demand. (Manuel Heitor, MCTES)

Nonetheless, aligning Portuguese HE to Bologna recommendations has been part of a more profound overhaul of the country's HE system triggered by an OECD review of tertiary education in Portugal (OECD, 2006). A range of initiatives taken by Portuguese authorities in the past years with no direct connection to Bologna can be traced back to the review's recommendations, generally reinforcing the contribution of HE to the economy and the society. Such are, for instance, new regulations regarding governance of HEIs to include external stakeholder participation; institutional autonomy allowing for diversity of organisation and legal status to facilitate responsiveness to market and society needs; growth in HE participation through provision of vocationally oriented first-cycle and short-cycle programmes; or increased transparency and scrutiny by the public.

However, Bologna offered an umbrella opportunity to bring about extensive reform at multiple levels and modernise higher education. It has been invoked as the justification for changes, as the Ministry representative frankly states:

> Bologna can be many things or can be nothing. One thing is the modernisation of the education system, either you call it Bologna or you call it any other name, it doesn't matter to us. What we want is a modern higher

> education system and we have used the so-called Bologna Process in order to use a political opportunity to make a reform. (Manuel Heitor, MCTES)

The different emphases in the discourses of national representatives illustrate an evolution from the educational and cultural dimension of Bologna early on to an economic, utilitarian one later (Tomusk, 2004). The scope of Bologna also seems to have been flexibly and creatively interpreted, with the political class pursuing under its umbrella a wide range of measures to reform the system beyond objectives related strictly to Bologna.

5.3.2 Academic reception

At institutional level, attitudes towards Bologna seem to have been determined by actions (or lack of) taken in the political arena. At the beginning of the decade, lack of information and debate at political levels meant that awareness of the Process was very poor in academic circles, not only in Portugal but across Europe, as the then Secretary of State for HE declares:

> I was very much aware that the institutions were not aware of the Bologna Process. I was for instance in Salamanca in March 2001 when the decision to create the EUA was taken (…) And I was really surprised that the directors and the representatives of higher education institutions were not really aware of what the Bologna Process was. (Pedro Lourtie)

Moreover, as the former Portuguese representative on the Bologna Follow-Up Group testifies, the preoccupation with structure proved alienating for academics. Not only did it fail to stimulate them, but the proposed structure seemed to contradict their core educational convictions, too. Structural arrangements clashing with academic beliefs might also explain the early reticence of disciplinary working groups to make amendments to degree design in accordance to Bologna recommendations. This statement illustrates the academic/political split:

> These are the four issues of Bologna: degree structure, ECTS measuring, accreditation and recognition. And this has nothing to do with academics. And the academics kept saying 'Well, Bologna is not interesting'. And finally the politicians understood that without the academics being mobilised to do the work, they would never do anything useful with Bologna (...) Let me give you

> an analogy between architects and engineers. I think the politicians behaved like architects. They said ‘Ok, we have this shape’. And then the academics behaved like engineers, they said ‘No, we cannot do that; that shape doesn’t work’. It happened in Greece in 2004 (…) The architect designed a very nice arch to cover the Olympic stadium. And the structural engineers arrived and said ‘No, we cannot do that. It’s impossible to do.’ And they discussed and the architect changed it. It’s like Bologna. They started ‘It’s 3+2 and that’s it’, for employability and whatever and so on. And then the academics said ‘Rubbish, you can never do that. You can never get the competences in three years‘. (Sebastião Azevedo, BFUG)

However, in the following years an attitudinal shift seems to have happened, manifest in an upsurge of interest in Bologna among academics. It might have been the failure of political initiatives to cater for academic concerns that stirred institutions to be proactive. Or the ‘black-out periods’ in political engagement might have caused concern that Portugal was lagging behind European developments. Thus, frustrated with government inaction, Portuguese universities grew tired of waiting for legislation and initiated ad-hoc processes of adapting study programmes to European trends. Public universities enjoyed autonomy thanks to the 1988 University Autonomy Act and encountered no obstacles in implementing changes, whereas the other HEIs, which needed ministerial approval, had their proposals rejected on grounds of lack of appropriate legislation (Amelia Veiga, Rosa, & Amaral, 2005). As a consequence, the two-week period universities had further to Law 74/2006 to submit proposals for new or adapted Bologna-compatible study programmes for the next academic year, should they want to, was marked by unexpected high levels of submissions (Amélia Veiga & Amaral, 2009b). Eager to adapt to Bologna, universities had started working on the re-organisation of degrees of their own accord in the absence of a legislative framework, as the following statement also illustrates:

> People thought that being the first to change proved that they were the best. So in spite of having a very short period between the publication of that common law and the date you had to present the programmes adapted to the Bologna Process, there were lots of institutions that presented their programmes. Our institution presented all of them. But we started working before that, and many institutions did that. But I think there was too much of a rush to change. (Pedro Lourtie)

Therefore, the academic constituency seems to have fully embraced Bologna after an initial period of unawareness and reserve. It is not clear whether the awakening emerged solely from a desire to align with Europe, or whether it reflects the academic perception of Bologna as a window of opportunity to change the pedagogical paradigm towards student-centred teaching (Amélia Veiga & Amaral, 2009b). If so, such an interpretation of the Bologna Process is, indeed, surprising since the concern with student-centred education is hardly present in Bologna official documents before 2005, and nor does it feature in the Portuguese political discourse.

Moreover, in Portuguese official documents references to student-centred education and a new teaching paradigm appear to have emerged as an acknowledgement of the academic perception. This would imply that Portuguese academia re-invented Bologna to suit their own preoccupation, with national policy-making bodies following suit. For instance, Decree Law 74/2006 acknowledges the fact that institutions 'have already begun work on the appropriateness of their courses to the new organisation model for higher education', the first objective of this endeavour being 'the transition from an education system based on transmission of knowledge to a system based on the development of competences' (MCTES, 2006b, pp. 4-5). Decree-Law 107/2008 went even further making compulsory for HEIs to report on progress on the Bologna academic objective of changing pedagogic paradigms.

The interviews with eleven academics involved in master programmes reveal no major differences in the reception and understandings of the Bologna Process between the two Portuguese universities in this study. Bologna appears to have enjoyed a positive reception in both, although in Institution 1 some reserve was noted about the initiative's external nature:

> … it was obviously sort of imposed on us, since funding was dependent on it we of course had to do it. And in that sense I think there was a lot of foot dragging in the beginning, and when the process started, our present president ended up having an important role in that process. So I think it was fairly well received, although with some scepticism (PI1.1)

Nonetheless Bologna was seized as an opportunity to make changes to improve study programmes:

> It was seen both as a hassle and an opportunity; an opportunity because we always think that a degree like physics (...) could always be improved. I felt that as a student, I still feel this. And the Bologna agreement and restructuring the whole degree was an opportunity to put things right or in the best way. (PI1.6)

Institution 2 is also reports to have adopted an embracing attitude. Already prior to the legislative changes it started to engage with Bologna through the enthusiasm of senior staff and dissemination of information across the university:

> …there's a lot of exchange and people are interested, and our previous rectors and vice-rectors always engaged a lot of action in the Bologna Process. So they have meetings with professors telling what is going to change, why we are doing these changes, so gradually we, as lecturers and professors, are getting the flavour of what it is, not just reading the regulations and the treaty, that does not tell us much; it helps us to see why we are doing this. (PI2.4)

Two aspects of the Bologna Process come across as most noteworthy for teachers: first, Bologna embodying a new pedagogy, student- rather than teacher-centred; second, the new degree structure, i.e. 3+2. The latter aspect is unsurprising, an expected outcome of Bologna's emphasis on structural convergence – however the misperception of Bologna requiring 3+2 is worth noting. Reactions to the new degree structure are addressed in section 6.3.

The former aspect, a new pedagogical paradigm, is surprising. With one exception, all interviewed academics talk about Bologna as an opportunity to change teaching approaches, transforming students into independent learners at the centre of the educational process. It is on the pedagogical dimension of Bologna that teachers dwell considerably in their accounts. Student-centred education is understood as a shift in mainly the students' attitude, accused of being passive:

> We had some hope that especially the students' attitude, probably the teachers' also, but I think mainly the students' attitude with respect to learning would be different.Everyone I think complains that students take a very passive attitude. They go to lectures, sometimes they take notes, but they don't really follow, they don't work along the semesters, so they mainly study

> near the exams. And we have kept repeating to them and to ourselves that this has to change, you have to get more involved and it is your duty to take care of your learning process, but I'm afraid that has not changed too much. (PI1.2)

…and as a more flexible curriculum allowing higher student input in designing their own study programme, manifest in both course choice and change of degree after the first cycle:

> …there is another point, very important. We centre the choice of course on the students. Now we don't have a course that students come here from the first to the fifth year and should follow. No, they can choose at the end of the first cycle what they do, in Portugal or another university, and that depends just on them. They have all the *unidades curriculares*[8] defined, they can look at the programmes and decide. (PI1.3)

Teachers in both universities express nonetheless reserve about the success of student-centred approaches so far.

Three national representatives (all with a foot in academia at the time of the interview) confirm this pedagogic perception of Bologna in institutions. One highlights, however, the multiple interpretations of the pedagogical shift in practice and how it represents different things for different people:

> …some people say Bologna is working with tutorials, in small groups. And then some people understand tutorials in different ways, because some of them are working with small groups on subject matters, on projects and so on; for others tutorial is to have someone that guides you through your academic life, but not on disciplines – and so this confusion, because people are using the same words to say different things. So in some institutions they divided the rooms because they are going to work with small groups. Some say in Bologna you shouldn't have big classes, big theatres, because you should never work with big groups (...) Others say Bologna is the programmes having majors and minors. (Pedro Lourtie)

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[8] Courses composing a degree.

Alongside a new pedagogical approach, mobility is also highlighted as an opportunity presented by the Bologna Process.

Students appear to have been generally hostile to the changes proposed by Bologna. Initially they could see no benefits in importing an outside system and changing the status-quo. Even though there existed pockets of confidence that Bologna could be turned to the students' advantage, once implementation was underway, the student mood again turned against Bologna. Students felt that it was detrimental to the quality of their university experience and education:

> We went through a number of different phases (...) So when it appeared, the majority of the student movement felt that this was unnecessary and this was unwanted. And it was also some sort of – I don't know, it's a strong word – but almost cultural colonialism, imposing a model to other systems of higher education as if there were a preferable model to impose. So the reaction was very strong: we don't want it and we will not get involved in it. (...) And then there was a change, there was a greater openness to the idea of actually profiting from the Bologna Process till the moment when we got to the actual implementation. And that's when things went wrong again and there was a very strong reaction to the Bologna Process. Even though we didn't see very strong student demonstrations and protests, all across the different campuses there were complaints, there was a feeling that something was being taken from them in terms of quality, in terms of what kind of experience they wanted from the university, so I would say that the implementation phase was the worst part. (Bruno Carapinha)

The student representative also highlights the lack of a strong student union and the fragmentation of interests and influence. Besides, the constantly changing student population means that visions and priorities are volatile. The political perception is that students have been passive, losing the opportunity to contribute to the implementation of the Bologna Process:

> Actually we have tried in our law to strengthen very much the role of students in the pedagogic councils. Students must have a very important word to say to put a strong pressure to change and to continuous improvement, because education can always be improved (...) but student unions have become in

> my view very lazy in this process. They have been very much away. (Manuel Heitor)

The Portuguese case exemplifies an unusual instance of policy-making and implementation. National political actors have relied on legislation as a lever for reform to implement a new system aligned to Bologna recommendations. Initiatives have addressed the structural reconfiguration of the HE system. At the same time, Bologna's boundaries have been interpreted flexibly and a range of other unrelated reforms were pursued nationally under the umbrella of the Bologna Process. However, institutions and chalk-face academics added a further dimension to the Bologna reforms, not originally on the political agenda: a shift in the pedagogical paradigm. This corroborates Veiga's findings that the emphasis placed by academia on pedagogic reform within Bologna was an unintended consequence for the pays politique (A. Veiga, 2010, p. 378).

The impetus to review study programmes evidenced by the high number of new programme proposals points to a case of bottom-up engagement. Frustrated with perceived state inefficiency and the absence of a regulatory framework, institutions and academics ran ahead of political initiatives destined to bring about changes. Legislation aiming at implementing the Bologna recommendations came rather late, generating concern in the sector of falling out of pace with Europe. Therefore, reform in universities was already in the making when the political class enacted legislation. Even more surprising, the scope of the reform was pushed wider to include pedagogy not just structure, as initially envisaged. However, despite shared enthusiasm about the pedagogical reform, a shared understanding lacks about what it entails in practice. This might be an outcome of the uncoordinated emergence of student-centred initiatives at the chalk-face where practices display institutional and disciplinary variety. It thus appears that in Portugal institutions not only anticipated policy, but also reinterpreted it to suit their own preoccupations which subsequent legislation afterwards legitimised.

5.4 Denmark

5.4.1 National/Political reception

Representatives of Danish national authorities suggest that Denmark welcomed Bologna as an opportunity for international collaboration in higher education and as an initiative that chimed with the Danish political HE agenda. The words of Anne-Kathrine Mandrup from the Ministry of Science, Technology and Innovation are illustrative:

> I think it has been well received in Denmark. I think a lot of the issues which are part of the Bologna Process have either been simultaneously issues in Denmark or they might have raised awareness of some of the same topics in a Danish context. (Anne-Kathrine Mandrup, Ministry)

National representatives unanimously identify recognition of Danish degrees as Denmark's main motivation for embracing Bologna. A preoccupation with the europeanisation of Danish HE is evident in a publication by the Danish Rectors' Conference (later Universities Denmark) stating in relation to Bologna that 'Denmark is working to further the European dimension in higher education' (Danish Rectors' Conference, 2002, p. 20) and making reference to student mobility. Recognition of Danish degrees is portrayed as crucial to the internationalisation of Danish universities and mobility:

> With having more transparency and easier roads to recognition of course we would be able to enhance the number of students going abroad in Denmark, and of course it is very important that Danish students who choose to study abroad will at least have a higher level of guarantee that they can have their credits recognised when they return to Denmark. (Michael Huss, Agency for International Education)

Kalapazidou-Schmidt (2009) also highlights European trends as significant influences on Danish HE policy. A comment by the Ministry representative suggests that universities needed to change and the Bologna reforms resonated with the necessary transformation of Danish HE:

> ...there might have been a sense of a need for change with more students coming into universities. I can't really say why. But most importantly, I think it has been discussed as a political issue, it hasn't been implemented as a pressure from outside (...) there have been political discussions that we need to change our universities. (Anne-Kathrine Mandrup, Ministry)

Besides the europeanisation driver, HE reforms seem to have been triggered by increased political attention to the contribution of education and research to the economy, prompted by an OECD review of university education (OECD, 2004). Danish HE was in itself successful and producing high quality research – for instance Denmark surpassed all EU countries and the United States as the country with most cited publications per million inhabitants (69 compared to an EU average of 31 and 50 for the United States) (Danish Rectors' Conference, 2002, p. 16). As a Universities Denmark paper suggests:

> It is important to note that the Danish university system, as it was before the reforms, was neither functioning badly, nor in crisis. So it was not a need for great changes in the sector's basic structure that caused the university reforms. (Oddershede, 2010, p. 1)

However, the OECD review highlighted a number of weak areas. In a country where expenditure per student in higher education is above the OECD mean, spending more than any other OECD country on student support grants as a proportion of education expenditure (OECD, 2004, p. 6), low completion rates and the long time students take to graduation are a target of criticism (OECD, 2004, pp. 14-15).

The review underlines a new role for universities, shifting from developing knowledge for its own sake to preparing students for future employment. It criticises the government for not acknowledging this role and for lacking clear policies on the objectives of universities believed not to realise their full potential related to their economic function in the society. As a result, the review criticises the low emphasis on student employability, and suggests broadening the too research-focused teaching approaches to ensure graduates are prepared for their place in the economy (OECD, 2004, pp. 7-8).

Further to the review, in 2006 the Government published a globalisation strategy proposing extensive reforms in the fields of education, training and research, *Progress, Innovation and Cohesion – Strategy for Denmark in the Global Economy*. A large part of proposals aim at strengthening the quality and governance of education and research. Measures related to HE include (Danish Government, 2006, pp. 17-23):

- at least 50% of people to complete an HE programme in 2015
- institutions to reduce drop-out rates (via development contracts and economic incentives)
- revision of student grant support rules to encourage earlier start and to discourage delays

- more young people to study engineering, science, IT, health through the provision of attractive packages
- basic funds of universities to be distributed according to quality of research, teaching and knowledge dissemination
- university knowledge to be utilised in the society and knowledge exchange to influence funding allocation
- integration of government research institutions in universities
- university programmes to be evaluated according to international standards (and the creation of an independent accreditation body)
- bachelor programmes to lead to employment opportunities
- dialogue with employers.

Legislation and regulations enforced in the past decade can thus be attributed partly to the implementation of the Bologna Process and partly to the greater reform affecting Danish HE. For instance, the Diploma Supplement was made compulsory in 2002 and ECTS in 2001 (Danish Rectors' Conference, 2002, p. 20). The 2003 University Act indicates the three Bologna cycles as the study programmes universities can offer in a 3+2+3 structure based on ECTS (even though a 3+2 Bachelor-Master structure existed in theory already since 1993, but was not implemented in practice). The 2004 *Ministerial order on bachelor and master's programmes (candidatus) at universities* defines in detail the two degrees regarding purpose, organisation, entry requirements, examinations and curriculum. It also prescribes in detail study programmes descriptions (*studieordninger*), including an item on academic and vocational skills to be acquired (i.e. learning outcomes). In 2007 *Law on the accreditation institution for higher education programmes* (Ministeriet for Videnskab Teknologi og Udvikling, 2007) establishes ACE Denmark, the agency charged with the accreditation of existing and new bachelor and master programmes. There was also a requirement from the Ministry that universities should start employing learning outcomes, as the Ministry representative states:

> I think it was in 2003 that universities were told that they had to implement this way of thinking, learning outcomes, which was more competence-based. And they had a letter from the Ministry, and they had the Danish Qualifications Framework, and it said you have to implement this. You have two years and then we have to see it in your *studieordninger*. So that was a demand. (Anne-Kathrine Mandrup, Ministry)

These regulations are clearly Bologna-driven, intending to implement tools and elements which will align Danish HE to the recommendations of the Process. They address structural and descriptive dimensions of the HE system (degree framework, diploma supplement, ECTS, use of learning outcomes), giving quite detailed specifications.

However, other legislative initiatives have no direct connection to the Bologna Process, but can be attributed to the OECD review and the Government's globalisation strategy. The 2003 University Act changed the governance regime from a collegiate system to one giving weight to external participation, now in majority on university boards, marking a dramatic shift of power from internal to external stakeholders. New financial regulations reinforced the already output-driven funding regime (the taximeter system) which granted funding to universities on students passing exams according to their ECTS value. They aimed to improve completion rates and times, for instance to reduce the age of entrants to HE and to reduce the duration of studies, i.e. extra rewards for universities if students complete the degree and if they do it within the fixed time. According to Oddershede, the latest Finance Bill shows a reduced size of the normal education taximeter and the addition of a range of bonus arrangements that universities get when students finish on time (Oddershede, 2010, pp. 4-5). The *Law on transparency and openness in education programmes* requires universities to make public student evaluations of their courses (Ministeriet for Videnskab Teknologi og Udvikling, 2005), thus emphasising accountability. National interviewees' accounts and examination of official papers do not indicate that Bologna was used as an argument to push ahead these reforms. For instance, the 2006 government strategy does not mention Bologna.

In summary, the Bologna Process has been implemented through legislation alongside other major reforms of the HE system. Political commitment to the Bologna Process appears to have been high, motivated by a concern with europeanisation. Two national representatives make reference to the scorecards placing Denmark in one of the leading positions. However, one also tentatively suggests that progress has been due to the relatively easy implementation in Danish universities, since it did not imply massive changes.

5.4.2 Academic reception

The views of academics interviewed in this research display striking similarity in the two Danish universities. They all understand Bologna as an initiative aiming at greater resemblance among European degrees: ‘a sort of uniform system in the EU in terms of education’, ‘an attempt to standardise the educational programmes of European universities’, ‘mainly the 3+2+3 structure of the teaching programmes’, ‘make the different educations in Europe transferable’ or ‘task undertaken in order to facilitate the comparison between education in different European countries’.

The purpose behind the convergence of degree structures is unanimously recognised as student mobility. The lecturers’ expectation from engaging with Bologna is also mobility, namely students changing careers and institutions, not only across countries but also within Denmark:

> ...to have transparency for physics education, so that the students can transfer from one university to another according to their interests. I think that’s the main thing. (DI1.3).

In both universities one dimension stands out as associated with Bologna: the 3+2 structure. ECTS also emerges to some extent in one institution; however, this might be related to the university having been granted ECTS label. Interviewed academics’ association between Bologna and the 3+2 structure probably also provides the explanation for the reactions the Process awakens: indifference and scepticism.

As the 3+2 degree organisation was officially introduced in 1993, its reiteration in the context of Bologna did not mark a big difference. Thus, on the one hand there is indifference, since the required change was not structurally difficult to implement in the existing system, and therefore did not provoke anxiety. Structurally it was a minor issue, not a matter of debate among teachers:

> There was no big change that had to be done, and therefore I think we didn’t think it was much of an issue. People were not spending time worrying about it. It was a nuisance, but it had to be done so we’d just do it (...) It was fairly easy to implement in our system, so we didn’t really bother too much. (DI2.2)

On the other hand, despite an official 3+2 structure, the bachelor had never been deemed a valid exit degree. Thus, teachers report scepticism and disapproval towards the bachelor, described as an artificial degree justified neither by academic concerns, nor by Danish society needs, decided by politicians remote from academia:

> ...people felt this was decided. It didn't come from the inside. It was decided by some politicians who didn't have their fingers into the matter. And the second thing is, there was nobody out in the industry or anywhere that really felt they needed this bachelor; what they wanted was a master degree. (DI2.1)

National interviewees' perceptions of the universities' attitude to Bologna are more positive than opinions at the chalk-face suggest, echoing little the interviewed academics' indifferent views. Some identify universities as a driving force behind the implementation of the Bologna Process, whereas others believe implementation was unproblematic because it did not mark a big change in relation to previous arrangements:

> I think at universities it has also been well received, I think a lot of university persons have been involved, it was also a bottom-up process, and I guess this is what is so special about the Bologna Process that there are so many bottom-up processes which have kind of directed the development of the process itself. (Anne-Katherine Mandrup, Ministry)

Some voices mention the lack of public and academic debate around Bologna, and the fact that it failed to engage spirits beyond political circles – again an indication of indifference:

> I don't think it has met a lot of criticism from students or teacher organisations or researchers. It's been quite calm. The university reform caused a lot of criticism, but Bologna as such was not mentioned as much (...) It is mostly discussed in the ministry and the civil servants have implemented it, but not in a way in which there has been a public or political discussion about the goals of the Bologna Process. (Lena Scotte, DSF)

> I think in the broad public it went rather unnoticed. We haven't had a lot of public discussion on the implementation of the 3+2 structure. (Rikke Skovgaard, DU)

It is therefore unsurprising that the student representative criticises the level of knowledge about Bologna in institutions. Referring to the various government initiatives which have impacted the sector, she suggests that among academics there is confusion over which ones have been triggered by Bologna:

> … there have been structural changes in the governance of the universities, so today there's less clear dissemination in decisions, so that students and employees have more difficult times to influence the decisions made by the leaders of the universities (...) And in some people's minds that is also linked to Bologna. (Lena Scotte, DSF)

In summary, it appears that at national/political level Bologna received considerable attention as a vehicle for europeanisation, setting off a series of legislative measures to align Danish HE to the Bologna recommendations: enshrining in law the three cycles and associated ECTS; creating an accreditation agency to complement the existing quality assurance system with an accreditation one; making the Diploma Supplement and learning outcomes compulsory. These legislative actions occurred simultaneously with an extensive reform of Danish HE, not pursued in the name of Bologna but driven mainly by the globalisation strategy. However, confusion exists in the sector over the source of changes, whether Bologna-related or not.

The positive reaction at national level is not mirrored by the interviewed academics' views revealing a rather indifferent attitude to Bologna in institutions. Bologna is perceived as a structural initiative reiterating the 3+2 degree structure, not marking a radical transformation from the previous system. It only made a more convincing case for what was already in place. Therefore it failed to cause major reactions. The mobility dimension is valued as bringing benefits for students. In parallel, a sceptical attitude is evident further to the association between Bologna and the implementation of the unpopular bachelor degree.

Chapter 6 What is a Master Degree?

This research builds on the epistemological premise that meanings determine actions – thus the implementation of the master degree and teaching and learning practices are determined by policy actors' conceptions of the master. This section addresses these conceptions. Teaching and learning practices as manifestations of the master are the next section's focus.

Implementation actors occupy different decision-making levels in different national settings, which combined have an influence on conceptions of master education – hence my attempt to capture the evolution of understandings along the implementation staircase (European actors, national level actors, academics and students) in each national context, as well as differences and continuities across the three national contexts.

To systematise the analysis, a number of aspects are considered: structural aspects, purpose of the master degree, relationship with the bachelor, student competences[9] and research dimension. I draw upon two information sources: interview data and literature (research and official documents) addressing master-related issues.

At institutional level conceptions are informed by practice and experience, therefore they tend to be more nuanced than at European and national level where they tend to be rather general.

6.1 European perspective

A number of reference documents describe master degrees with respect to credit ranges and level descriptors (competences and learning outcomes): the conclusions of the 2003 Helsinki conference on master degrees, the Framework of Qualifications for the European Higher Education Area (FQ-EHEA), the Tuning project and the

[9] This research adopts the term 'competences' as the umbrella concept describing the combination of student knowledge, understanding, skills, abilities and attitudes resulting from the process of learning. This is according to the Tuning definition of competences, distinct from learning outcomes which express the level of competence attained by the learner and are formulated by academic staff. However, competences and learning outcomes sometimes also appear together undifferentiated; for example, the QF-EHEA states that it comprises 'descriptors for each cycle based on learning outcomes and competences'. In this research, learning outcomes will be used in a narrower sense to refer to academic practices of course description and their relevance for teaching approaches. In interviews, in order to find out about competences questions referred to 'student characteristics'; this term was employed to avoid the use of a specialised concept which could lead to different interpretations and/or limited answers.

ECTS Users' Guide (European Commission, 2009). In addition, several studies have investigated master degrees in Europe from a comparative perspective (Alesi, et al., 2005; H. Davies, 2009; W. Davies, 2007; Tauch & Rauhvargers, 2002).

In the decade following the 1999 Bologna Declaration, a consensus emerged that although structural convergence was increasing, the Bologna Process would not achieve the extent of degree comparability originally envisaged (Alesi, et al., 2005; H. Davies, 2009; Kehm & Teichler, 2006). The master degree is an example of the variation still present in European HE systems.

Davies argues that although a master template is emerging, there is still great diversity in its provision (H. Davies, 2009). Several explanations seem plausible: first, although reference points exist as shown above, these are either structural (ECTS ranges) or highly generic statements of intended outcomes of learning (Dublin descriptors), accommodating considerable autonomy and flexibility for countries and HEIs to approach implementation; second, they are non-prescriptive; third, structural recommendations are not precise, again enabling national and institutional adaptation. This respects the idea of convergence which replaced harmonisation in the move from the 1998 Sorbonne Declaration to the 1999 Bologna Agreement.

6.1.1 Structural aspects

Further to a survey of master degrees in Europe, Tauch and Rauhvargers recommended that the EHEA master should require 'normally the completion of 300 ECTS credits, of which at least 60 should be obtained at the graduate level' (Tauch & Rauhvargers, 2002, p. 7). The recommendation was based on evidence of trends towards a common template of the master amounting to five years of study. The 2003 Helsinki conference on master degrees built on this study, recommending that a master should carry between 90 and 120 ECTS, with 60 normally assigned to one academic year. It further stated the minimum requirements for master degrees as 60 ECTS because 'as the length and the content of bachelor degrees vary, there is a need to have similar flexibility at the master level' (Conference on Master-level Degrees, 2003, p. 5). The 2009 revised *ECTS Users' Guide* states again that second cycle qualifications typically include 90-120 ECTS credits, with minimum 60 ECTS credits at the level of the second cycle (European Commission, 2009, p. 16). The FQ-EHEA recommendation is identical to the *ECTS Users' Guide* provision.

This flexibility has translated into diverse degree organisation models based on the bachelor-master progression. Regarding duration, findings reveal 3+2, 4+1, 4+2 and 3+1 patterns. There is no consensus about the dominant model. Researchers mainly indicate the prominence of 3+2 (W. Davies, 2007; Kehm & Teichler, 2006; Tauch, 2004), but more recent papers and reports also mention 4+2 (Birtwistle, 2009) or five or more years of study (H. Davies, 2009). Davies thus describes the length of the master as an issue that "looms large in the minds of those implementing the changes" (H. Davies, 2009, p. 33). The EC representative believes that concerns with length derive from the master still being perceived as a component of students' initial training:

> ...obviously if you focus on the initial training and you want to strictly arrive to the five years study kind of level, the fact of having different patterns is perceived as a drawback by academics (...) We are more used to work on initial training masters and not so much on continuous training masters, in which this difference in patterns is much less relevant. (Endika Bengoetxea, EC)

Trends 2010 points to evidence that 'an erroneous belief has developed in some quarters' that the FQ-EHEA requires a 3+2 or 180 ECTS+120 ECTS model, or a cumulative total of 300 ECTS for 1st and 2nd cycle' (Sursock & Smidt, 2010, p. 60).

6.1.2 The master degree's purpose

Trends 2010 notes the introduction of the master degree across Europe in the last decade as a new, separate second-cycle qualification. It has proved to be a very flexible degree, defined differently depending on institutional and national contexts (Sursock & Smidt, 2010, p. 19). It has thus emerged as a qualification with multiple purposes. The EC representative welcomes the diversity of master programmes and institutional autonomy, enabling degree design according to university profiles. A key aspect in his view is the lifelong learning and continuous training function of the degree, allowing people to retrain or update their knowledge, despite the master currently being regarded mainly as initial training:

> ...most people regard masters as courses that you only can study once in your life. But a person could study several of them in different periods just to update skills, also try to re-orientate the professional career in one or another

> direction. We see masters as an integral part of the lifelong learning strategy for higher education. (Endika Bengoetxea, EC)

Davies (2009) has identified three main types of master programmes: taught degrees with a professional development focus delivered flexibly (full-time, part-time, distance and mixed); research-intensive degrees paving the way for the PhD for the career researcher; and master degrees offered to 'returning learners on in-service, executive release' (H. Davies, 2009, p. 12).

In addition, Davies lists the following categories encountered across Europe:

- Academic master – used in binary systems to distinguish university-based programmes from professional masters awarded by non-university HEIs
- Professional master – awarded by non-university HEIs in binary systems
- Consecutive or continuation master – following immediately, or soon after, a bachelor qualification in the same discipline
- Conversion master – undertaken in a discipline other than that studied in the preceding bachelor
- Joint master – delivered by two or more HEIs awarding single or multiple diplomas
- Lifelong master – used in some systems to designate second cycle provision delivered separately from the consecutive master (H. Davies, 2009, pp. 12-13).

Besides fulfilling a number of different purposes, the variety of designations for the master compromises its readability (Davies, 2009). However, on the positive side, it has emerged as the most flexible degree in the cycle system, 'at the point of intersection of professional development, research, innovation and knowledge transfer'. It is a versatile qualification which 'has a wide range of functions, addresses a wide range of clients, and is capable of rapid and flexible response to social and economic needs' (H. Davies, 2009, pp. 71-72).

Davies identifies better readability as a priority. He thus proposes a series of markers indicating the salient features of master programmes and urges countries to start making efforts towards their adoption so as to make the degree more transparent across Europe (H. Davies, 2009, p. 69).

6.1.3 Relationship with bachelor

Davies (2009) highlights the fact that in 2009 the following characteristics identified the master: location in the second cycle, level descriptors, bandwidth in the ECTS system, and typical duration of one to two full-time academic years.

These are, however, predominantly surface indicators. Although 95% of surveyed institutions declare to have implemented the cycle system (Sursock & Smidt, 2010, p. 33), implementation appears far from synonymous with clear first and second cycle identities. Davies, too, points out that the master 'has still to achieve a stable European profile in terms of pedagogy, labour market relevance, research-relatedness, funding and finance' and that a clear profile is hindered by the persistence of strong pre-Bologna traditions and by the lack of legislation regulating postgraduate programmes in several countries (H. Davies, 2009, p. 13).

In addition, the fuzzy profile is confounded by the first cycle's lack of distinctiveness. According to *Trends 2010*, first-cycle qualifications accepted by the labour market were a key motivation behind having a three-cycle system. However, labour market acceptance is conditioned primarily by acceptance in universities. In this respect, the report reveals significant concerns about the perceived worth of the bachelor: only 15% of surveyed institutions consider it as proper preparation for employment, a modest increase from 11% in 2007 (Sursock & Smidt, 2010, pp. 39-40).

Consequently, in some countries the master remains 'the basic entry-to-labour-market qualification', whereas in countries where the bachelor is the basic qualification the master becomes 'a value added to the CV of those already in the labour market' (Sursock & Smidt, 2010, pp. 38-39). Davies (2009) believes that the master will gain distinctiveness as the bachelor gains broad acceptance, and that as more students complete Bologna masters, its profile will become better defined.

In a written interview, Davies also mentions that in some countries where the bachelor is new (e.g. Austria, Germany) industry and government organised campaigns to consolidate its acceptance. He also predicts that it will become more secure 'as mobility in the European labour market increases; as tuition fees render long courses less affordable; as master programmes become more available as 'later-in-life' options; and as Europe shifts to a high-skill economy'. The EC representative also highlights a vision of the master as a complementary qualification, not integral to students' initial training:

> We don't consider that masters are a must for every graduate (...) But we understand that many graduates would be interested in following a master in the future if they want to focus their career or if they want to update their knowledge (Endika Bengoetxea, EC).

He believes that despite the achievements of the EHEA, Bologna reforms are still ongoing and with time the master as continuous training will become common practice:

> ... at the beginning countries have focused mainly on the reform of initial training studies, which is understandable. We think that in the next years lifelong learning in higher education will evolve and that more continuous training masters will emerge. An important aspect are also employers who also need to get familiar with it. (Endika Bengoetxea)

6.1.4 Student competences

An aspect which distinguishes master programmes from other qualifications is the level of student attainment on completion. In 2004 the Joint Quality Initiative specified criteria determining at which point in their learning journey students have reached the levels corresponding to the three cycles. These came to be known as the Dublin descriptors. In 2005 they were included in the FQ-EHEA as 'generic descriptors for each cycle based on learning outcomes and competences'.

For the second cycle, they are awarded to students who:

- 'have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
- can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
- have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting

on social and ethical responsibilities linked to the application of their knowledge and judgements

- can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously
- have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous'. (Bologna Working Group on Qualifications Frameworks, 2005).

What therefore stands out are: advanced knowledge, potential for originality, knowledge application in contexts of uncertainty and complexity, analytical and critical thinking, communication skills and independent learning.

The importance of competences as degree descriptors is underlined by the EC representative. The Diploma Supplement becomes an important vehicle for degree readability – reminding of the transparency and convertibility approach (Wächter, 2004) rather than the convergence one:

> ... masters degree diplomas are not meaningful enough at international level. The most important is to focus on the skills acquired, and this information is provided in the Diploma Supplement. That is why we are promoting its use extensively. We are aware of the need to familiarise employers with it. But at least we can say that currently in the academia, by reading a Diploma Supplement of a concrete master from another country, universities can understand whether you are eligible to register for a PhD directly or not (...) Thanks to the DS there is a better understanding of which are our competences, what we studied. (Endika Bengoetxea, EC)

6.1.5 Research dimension

Research emerges as a significant dimension of master education. The *Survey of Master Degrees in Europe* (H. Davies, 2009) highlights that most master programmes contain a research component, with only 21% of HEIs and 17% of academics reporting that research was not systematically included. Depending on institutional and pedagogic contexts, it was theoretical or practical, an individual or group activity, expressed as a thesis or as projects or assignments. Therefore, the research component was 'accepted and non-controversial' and appears as a ‘defining feature’ of the Bologna master. However, only half of student respondents were satisfied with the research opportunities offered by their degrees (H. Davies, 2009, p. 49).

The Dublin descriptors also mention research: second-cycle students’ breadth and depth of knowledge is expected to provide ‘a basis or opportunity for originality in developing and/or applying ideas, often within a research context’.

In summary, the master emerges across Europe as a degree displaying a broad variety of types and purposes. On the plus side, this renders the master the most versatile degree, but on the minus side it prevents readability. Structurally, flexible credit ranges and recommended durations materialised in different implementation patterns. Although many countries have passed legislation establishing the master, it has not yet acquired a clear and stable profile. This is hindered by persisting national HE traditions and by the bachelor’s lack of individuality, still met with reserve by employers, academics and students. Depending on previous degree organisation, the master is either the basic degree guaranteeing entry to the labour market or an added bonus to students’ CV. Nonetheless, predictions are that the master will establish itself as a lifelong learning qualification, although at present it is still regarded as initial training. Master students’ defining competences are advanced knowledge and understanding, ability to apply knowledge to new situations while dealing with uncertainty and incomplete information, communication skills and learning skills. Research emerges as a non-controversial and defining dimension of master education.

6.2 England

The various durations of the bachelor-master structure across Europe have raised questions about the Bologna-envisaged degree comparability. In particular, one discrepancy from the predominant model(s) has come in the spotlight: the one-year master in the UK[10] following a three-year bachelor, whose duration is set against one and a half or two years in most continental European countries (W. Davies, 2007; Royal Society of Chemistry, 2008; Tauch & Rauhvargers, 2002; Witte, 2006).

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[10] The master in Scotland is not deemed contentious given the Scottish 4+1 bachelor-master structure (Johnson and Wolf 2008).

Regarding credit range, one-year masters in England are normally allocated 90 ECTS. The revision of the *ECTS Users' Guide*, no longer stating that 75 ECTS is the maximum amount which could be allocated to a full twelve-month calendar year (European Commission, 2004, 2009), has brought some reassurance in English quarters.

Controversy started to surround the one-year master around 2004. Its shorter duration unleashed criticism from continental Europe (Kehm & Teichler, 2006; Tauch, 2004). It has also provoked anxiety at home about the perception that the degree is light-weight (Europe Unit, 2004b; House of Commons Education and Skills Committee, 2007b), and less rigorous (Cemmell & Bekhradnia, 2008), as well as about the threat that such perceptions might pose to the reputation and competitiveness of UK HE (Bone, 2008; Cemmell & Bekhradnia, 2008; H. Davies, 2009; House of Commons Education and Skills Committee, 2007b; Johnson & Wolf, 2008; Newman, 2008; Royal Society of Chemistry, 2008) and UK postgraduates (House of Commons Education and Skills Committee, 2007a; Smith, 2010).

The UK Europe Unit representative identifies the master degree as the main Bologna enquiry with which the UK Europe Unit has had to deal and which was an important factor in the establishment of the Unit. However, according to most national spokespersons interviewed (BIS, QAA, UK Europe Unit, NUS), the length of the English master has ceased to be an issue in Europe. The self-certification of the *Framework for Higher Education Qualifications for England, Wales and Northern Ireland* against the FQ-EHEA in 2009 is claimed to have ended the debate, confirming the legitimacy of the one-year master as meeting the Dublin descriptors and the recommended credit ranges. Moreover, national representatives highlight the existence of shorter master programmes elsewhere:

> I think that the work Wendy Davies did a few years ago, *Mastering Diversity*, showed actually it may be somewhat of a myth to assume that masters degrees elsewhere were all two-year full-time, that actually there's quite a lot of variation in different countries. So the UK might not stick out as much as people seem to suggest we do. (Laura Bellingham, QAA)

6.2.1 The master's degree – brief history

A brief overview of the evolution of postgraduate education in Britain in the past decades and the master's emergence will hopefully shed light on the functions and rationale of the one-year master. I draw on the comprehensive account provided by Becher, Henkel and Kogan in *Graduate Education in Britain* (Becher, et al., 1994).

Traditionally, university research was an independent activity undertaken for the advancement of knowledge, with few instrumental purposes. However, the 1970s mark the start of government intervention in setting research priorities for universities and increased concern about returns on public investment. For instance, the Expenditure Committee of the House of Commons in 1974 and the Public Accounts Committee in 1987 identify the primacy of instrumental objectives for postgraduate education, namely to meet the nation's manpower needs as opposed to traditional arguments around the pursuit of knowledge for knowledge's sake or scholars' intellectual development (Becher, et al., 1994, p. 29).

In parallel, debates in the 1980s around the purposes of the PhD – mainly whether it is research training or original contribution to knowledge – and around students' preparedness to pursue research led to a rethinking of postgraduate education. This had previously been funded for three years and mainly in departments unable to provide systematic training to underpin research studies. One-year master degrees therefore appeared as a means of facilitating a progressive transition from undergraduate degrees to the PhD. There was also an instrumental argument for a one-year master preceding a three-year PhD: it would ensure a more efficient use of resources by filtering out poorly motivated and weak students in year one.

As a consequence, gradual consensus emerges across disciplines and institutions for clearly differentiated stages of research education and a 1+3 structure, underpinned by 'questions of structured progression, training and professionalization in the context of a shift towards a mass higher education system' (Becher, et al., 1994, p. 52).

During the next decade the master degree is invested with a new instrumental dimension. In light of the new economic utility of research, policy makers perceive the labour market relevance of doctoral graduates as limited. Thus, in 1993 the government announces for the first time a substantive policy change in postgraduate education, namely a shift of resources from doctoral to master programmes. The master degree becomes the initial postgraduate degree in science, technology and engineering. The 1993 White Paper *Realising Our Potential – A Strategy for Science, Engineering and Technology* defines the MSc's role as follows:

> The arrangements for the training of postgraduate scientists and engineers will be developed so that the MSc can become the normal initial postgraduate degree in science, engineering and technologies and that the PhD training for those who progress beyond the Master's degree is properly underpinned. (Chancellor to the Duchy of Lancaster, 1993).

Besides, the White Paper stresses the supremacy of the employment objective of postgraduate education, stating that 'greater attention will be given to the relevance of postgraduate training for all careers'. It proposes the identification of employment and economic needs to inform priorities in research, and subsequently graduate education, in order to manage government investment in science and technology to better effect. Addressing the question whether postgraduate degrees are education or training, Burgess (1997), too, stresses the role of postgraduate studies (increasingly populated by mature students) for lifelong learning, as professional updating and re-skilling.

Following the 1993 White Paper, research councils and their boards are reformed, reflecting a managerial rationale and structure. They become accountable to government departments and economic objectives gain prominence. Further to this policy change, the 1990s witness the promotion by research councils of the expansion of master degrees as a policy priority. Councils also start emphasising their contribution, and that of graduate education, to the needs of the economy. Despite HEIs' discretion to propose and maintain courses leading to graduate qualifications, their freedom is restricted by funding allocations from research councils and prescriptions on quality and course pre-requisites (e.g. inclusion of particular components, such as methods courses, as a condition of studentships). Beyond this, however, decisions on contents and teaching methods belong to departments responsive to peer group influence (external examiners) (Becher, et al., 1994, p. 22). The British Academy, the Humanities source of support, remained alone in emphasising study for the sake of individual growth and for the pursuit of scholarship to ensure its continuity (Becher, et al., 1994, p. 32).

Becher et al underline, too, the other instrumental approaches behind the development of master degrees, namely the expansion of overseas markets to tap demand and the hope that successful students would stay to do PhDs.

One consequence of the revised function of graduate education triggered by external political and economic pressures has been the expansion of taught master programmes in response to new economy and society requirements of a different workforce (Becher, et al., 1994, p. 50). The growing importance attached to taught degrees is reflected in increasing proportions of research council studentships to these courses, especially those geared to the needs of the economy in science areas (Becher, et al., 1994, p. 61).

A considerable growth in postgraduate education, and especially in taught masters, is documented in a recent government-commissioned postgraduate education review *One Step Beyond: Making the most of postgraduate education* (Smith, 2010). Using HESA data, it shows that between 1997-98 and 2008-09 the total number of enrolments in postgraduate study has grown by 36% in UK HEIs. This is higher than the undergraduate growth over the same period (27%). Much of the growth is due to the rise in students coming to the UK from overseas. Regarding different types of postgraduate degrees, the report shows that the most significant growth has been in the number of people registering for taught masters – an increase of 46% between 2002-03 and 2007-08. At the same time, entrants to research-based qualifications (doctorate or research masters) rose by 14% (Smith, 2010, pp. 22-24).

To sum up, master degrees emerged as a prioritised postgraduate degree further to close scrutiny of the rationale for, and structure of, long research degrees (PhD), when support for the latter in the policy system declined on account of their limited relevance for economic needs. The master degree establishes itself initially as a foundation for research studies and a filter for research applicants. Subsequently it is assigned great economic relevance as advanced study catering for the needs of industry, government, and economy. It is also a flexible qualification able to respond to economic needs. It thus experiences a growth rate unequalled by any other qualification alone.

6.2.2 National/political conceptualisations

6.2.2.1 Structural aspects

Concerns with the lack of transparency of UK qualifications go back to the 1990s. Thus, the Dearing Report (Dearing, 1997) recommended the articulation of a qualifications framework. Specifically in relation to postgraduate qualifications, the Harris Report (Harris, 1996) highlighted their profusion and the need for a transparent typology.

Further to the Dearing recommendations, in 1998 the QAA issued a *Consultation Paper on Qualifications Frameworks: Postgraduate Qualifications* (QAA, 1998) seeking views on possible typology models. Further to the consultation, QAA opted for the use of two postgraduate levels: doctorates and certificates/diplomas/master's. Then in 2001 *The framework for higher education qualifications in England, Wales and Northern Ireland (FHEQ-EWNI)* identified the master as a distinct level. It was revised in January 2008 to comprise four levels (4-8), the master appearing as a level 7 qualification alongside postgraduate diplomas and certificates (QAA, 2008a, pp. 20-21). In November 2008 FHEQ-EWNI was self-certified against the FQ-EHEA (QAA, 2008b). As a result, in the past decade the master has occupied a clear position in the national degree framework.

However, a variety of master degrees within the overarching master category persists with regards to duration and credit ranges. According to a reference document for UK masters published by the QAA in 2010, *Master's degree characteristics* (QAA, 2010), most degrees (MA, MSc, MRes) last one calendar year of full-time study. Integrated master degrees (common in science, mathematics and engineering) are awarded on completion of a four-year programme (five years in Scotland) combining a bachelor's degree with study at master level. Moreover, there are MPhil programmes of 12 to 24 months with a dominant research orientation, and professional masters with a variety of durations.

The *Higher education credit framework for England* published in 2008 (Credit Issues Development Group, 2008) stipulates the typical minimum credit allocation for master's degrees as 180 credits (corresponding to 90 ECTS) of which at least 150 (75 ECTS) must be at master level. For an integrated master's there is a total credit allocation of 480 credits (240 ECTS), with at least 120 (60 ECTS) at master's level.

National interviewees acknowledge this variation. One respondent describes the master as ‘the most fluid and most adaptable’ qualification in the degree framework. Under the qualifications framework’s accommodating umbrella, the master degree takes different shapes and serves different purposes, which, according to the QAA representative, is a welcome occurrence:

> The advice is that if there’s master’s in the title, it should be meeting the national qualification descriptor (…) and it must have the right number of credits at the right level. Beyond that, there’s great variation, and we haven’t and wouldn’t try to do anything about that particularly because it’s regarded as healthy. It’s a healthy diversity that suits different needs and traditions of different disciplines, missions of different providers, the needs of different students. (Laura Bellingham, QAA)

The 2010 postgraduate education review draws attention to the variation in the length of postgraduate courses in the UK, stating that the UK master and PhD are ‘relatively compressed’ in comparison with courses in some other European countries, the United States and elsewhere. It urges UK HEIs to engage with the FQ-EHEA in order to ‘demonstrate that the learning outcomes of a one year full-time master’s course are aligned with those offered elsewhere’, that the UK degree is ‘both rigorous and challenging’ and ‘prepares students to be successful in a competitive employment market’ (Smith, 2010, p. 40).

As the review implies, length and credits are not favoured currencies in the UK to describe qualifications. It is by emphasising student learning outcomes instead of input elements that the one-year master claims parity of position with longer degrees. There is a perception among national representatives that the UK has travelled far in the understanding and usage of learning outcomes, while the rest of Europe is only now adopting them, with various interpretations in different countries. However, for the UK the focus is clear:

> It is learning outcomes that is our currency. So not how long a student studies, either per week or over the course of the whole degree, what the qualification of that student was on entry, what his or her career aspirations are. We take our currency as outcomes. That’s how we measure standards. (Laura Bellingham, QAA)

Invoking feedback from several stakeholders, the postgraduate review suggests nonetheless that in some disciplines ‘it may be advantageous to extend the length of courses to ensure postgraduates have sufficient time to develop the advanced skills and knowledge that they need to be successful in their career’. Chemistry is one such discipline, as illustrated by a report which recommends a duration of two academic years for master degrees (Royal Society of Chemistry, 2008, p. 3). The review also urges HEIs to ‘use the flexibility afforded in funding from the higher education funding bodies and the Research Councils, to offer longer periods of postgraduate research funding and training where appropriate’[11] (Smith, 2010, p. 6).

6.2.2.2 Purpose

Already in 1996 the massive growth and diversification of postgraduate degrees led to a postgraduate education review documented in the above-mentioned Harris Report. It voiced concerns about the profusion of qualifications and the confusion around nomenclature, and recommended eight qualification titles. For master degrees it suggested a small set of generic titles ‘perhaps MA and MSc, for postgraduate courses containing an element of personal work which is externally examined’ and ‘quite specific subject masters titles (for example, MEcon, MPharm) for advanced taught courses lacking such an element’ (Harris, 1996, p. 4).

Nowadays, QAA’s *Master’s degree characteristics* (QAA, 2010) identifies three indicative broad types of master’s with the following purposes:

- *Specialised/Advanced study* master’s (MA, MSc, MRes) enabling students to:
    - focus on a particular aspect of a broader subject area in which they have previous prior knowledge or experience
    - focus on a particular subject area or field of study in greater depth than they encountered during the course of previous study or experience (i.e. knowledge of a new discipline)
    - learn how to conduct research (often with a greater emphasis on structured learning as opposed to independent study)
- *Research* master’s (MPhil) – enabling students to undertake a research project, making up the majority of the overall assessment

[11] For a description of the HEFCE funding model see section 5.2.2.

- *Professional/Practice* master's (MBA, MEd etc) – enabling students to specialise in an area of employment related to a particular profession. (QAA, 2010, p. 4)

The Physics MSc – the object of this research – falls into the first category, envisaging specialisation within a discipline and initiation to research through a higher proportion of structured learning as opposed to independent study.

In relation to purpose, all three types aim to prepare students both for further research and employment, although as expected the research master's emphasises research to a great extent, whereas the professional master's stresses the competences needed in a specific profession.

Nonetheless, as the section on the evolution of the master showed, master degrees are normally expected to meet economic and labour market needs. The interviews with representatives of national agencies reinforce this view. Although they assign a dual purpose to the master, i.e. career orientation and springboard to doctoral research, their accounts suggest that the employment dimension has the upper hand. For instance, one interviewee notes that:

> I think at the moment it's very much focused upon gaining employment. If it's linked to doctoral study, I don't really see this coming through; PhD studies...the link is not immediately obvious. (Paul Dowling, Europe Unit)

The master thus appears as an opportunity for lifelong learning, professional re-skilling and career development. The 2010 postgraduate education review confirms this: around 60% of postgraduates study part-time (in taught master degrees 56% are part-time) and many stay in employment throughout. According to destinations data, part-time postgraduates in particular enjoy a high rate of return after graduating (Smith, 2010, p. 36).

Reinforcing these findings, the Higher Education Academy's postgraduate taught experience survey (Park, 2008) also identifies the top motivations for students as follows: 'to progress in chosen career path' (58%) and 'to improve employment prospects' (53%). The next most common motivations were 'personal interest' (45%) and 'to enable progress to a higher qualification' (32%). This suggests that employability features prominently in the reasons for undertaking taught postgraduate study, with further research (progress to a higher qualification) coming only fourth.

6.2.2.3 Relationship with the bachelor

In the English degree organisation traditionally based on the undergraduate/ postgraduate distinction the cycles have clear identities. As mentioned earlier, since the English framework was already organised in cycles change appeared unnecessary:

> …of course we already structured our education into the three levels. So we didn't have as far to travel, we already had three-year honours programmes, master degrees and PhDs. So I suppose that could be a reason why perception is the UK has been slow to grasp, because we didn't have a lot of reforms to implement. (Laura Bellingham, QAA)

The three-year bachelor has been and continues to be the default university preparation, with the majority of students stopping after it, as HESA data shows (HESA, 2010). In 2008/9 only 16% opted for further study, whereas 61.3% went into employment.

Activity	*2007/08*		*2008/09*	
Work only	135180	63.4%	133220	61.3%
Work and further study	17850	8.4%	17930	8.2%
Further study only	30940	14.5%	34740	16.0%
Assumed to be unemployed	17360	8.1%	20120	9.3%
Not available for employment	9175	4.3%	8625	4.0%
Other	2760	1.3%	2710	1.2%
Total	213270	100.0%	217345	100.0%

Table 6.1 Destinations of UK-domiciled first degree leavers in 2007/08 and 2008/09
(Source: HESA Destinations of Leavers from HEIs 2007/08 and 2008/09)

Consequently, the master is not a common choice, not considered an essential part of education. It is a qualification pursued to enhance one's professional standing, not because of a perceived deficit of undergraduate education. Some respondents describe the master as the qualification that makes one stand out from the crowd.

Moreover, the master student is portrayed as someone already in a professional role for some time returning to education, probably part-time, to improve their career prospects or to pursue a professional interest:

> I think one of the things that exercises a lot of people in the UK is moving away from this idea of a full-time master student that would be going straight into a master after doing a bachelor degree. I think there's a growing awareness that a lot of particularly UK nationals who are doing master degrees are probably doing it part-time, and probably had some previous work experience before doing it and identify the master degree as a tool to increase their employment status, employment prospects, earning prospects. (Paul Dowling, Europe Unit)

The postgraduate education review also highlights postgraduate study as a 'route to advancing in an existing career as well as opening up new employment opportunities' (Smith, 2010, p. 36).

6.2.2.4 Student competences

The FHEQ-EWNI (QAA, 2008a) comprises competences related to knowledge and understanding, general abilities and transferable skills.

Regarding knowledge and understanding, the following aspects stand out: broad as well as advanced knowledge 'at the forefront' of the discipline; originality in knowledge application; understanding of disciplinary enquiry or research techniques to advance knowledge; conceptual understanding and critical thinking to evaluate research, scholarship and methodologies.

In relation to abilities it emphasises: dealing with complexity and making judgements with incomplete information; independence in solving problems, initiative and originality; ability to advance knowledge and understanding.

With regards to skills, the following are mentioned: initiative; responsibility; decision-making in unpredictable situations; independent learning for continuous professional development.

Interviews add little to the above. Two interviewees refrain from commenting on master students' defining competences and refer to the learning outcomes defined for this educational level. Others mention specialisation in a knowledge area, independence and genuine motivation, since doing a master is not the norm in England.

6.2.2.5 Research dimension

An established distinction in the UK system, highlighted both in the *Master's degree characteristics* reference document (QAA, 2010) and the 2010 postgraduate review, is that between 'taught' and 'research' masters depending on the amount of structured learning versus independent study or a research project. However, most taught degrees include a research project and many research degrees will comprise some structured learning.

Master's degree characteristics describes the different weights of research. The specialist/advanced master's is a taught degree (MA, MSc, MRes), and one of its purposes is to enable students to learn to conduct research. Frequently at least a third of the programme is devoted to a research project. However, programmes focus more on the delivery of structured learning as opposed to independent study or a research project. The emphasis thus rests on the acquisition of research skills. In contrast, the purpose of the research master's (MPhil) is to enable students to undertake a research project making up the majority of the overall assessment. The emphasis thus rests on the development of a piece of research.

Related to the prevalence of the employability dimension discussed under the degree's purpose, a national interviewee mentions the lesser weight of research in the English master compared to continental Europe:

> I'm certainly more aware that students from mainland Europe probably are prepared to study a lot longer and expect much more of a research element to the master's degree. (Paul Dowling, Europe Unit)

Another respondent reinforces the instrumentalism of research in the English master, research not being an end in itself. While the master aims to develop research skills, this preoccupation is relevant insofar as it equips students with competences they will need in their future career. In depth research appears a PhD characteristic:

> Certainly in England a one-year master's is primarily seen as a mixture of both high level knowledge and also the research skills which are incredibly useful for employers. But they don't need that massive depth of knowledge or a full-on master's project, unless they're actually going on to do a PhD and go into academia themselves. So in a sense what a one-year master is very good for is providing advanced level research and advanced level knowledge which is very relevant to the market place. (Alex Bols, NUS)

In summary, literature and interviews with national actors reveal the following conception of the master degree in England: There is not one master degree but a diversity of degrees within the flexibility provided by the qualifications framework. Learning outcomes rather than credits or duration are preferred qualification descriptors. The master is a bonus qualification with a clear identity, adding value to students' CVs, and not a degree compensating for a deficient bachelor. Regarding purpose, evidence shows that students usually pursue a master to improve career and earning prospects, and less as a step to further research. This illustrates the evolution of the master as a degree responsive to economic needs, also reflected in the predominantly mature student population, in employment and studying part-time. As to the function of research in the master, research appears not as an end in itself (except the research master) but as a means to give students useful skills for their future employment. The preoccupation is thus with the development of research skills rather than with the production of a substantial research project.

6.2.3 Academic conceptualisation

6.2.3.1 Structural aspects

Two parallel perceptions emerge in the description of the master, one related to the European standard (taking the European norm as reference) and one related to the function of the master degree in the British tradition (taking the purpose of the master as reference).

Regarding the European standard, identified by respondents as the two-year master, there is general agreement that the English degree cannot be equivalent to the European one. As to the function of the English master, seen through the prism of student demand and the transformation it aims to bring in students, it is a legitimate degree, perfectly fit for purpose. The two do not appear easy to reconcile, leading to a dilemma over future actions. Will the European context and the potential dangers of non-alignment to the norm win over a degree generally seen as fit for purpose in England?

In the British tradition the one-year master is a fully legitimate degree, a ‘fine programme in itself’. In Institution 1 it is described as a degree giving students the necessary research skills to embark on a PhD, and the majority view is that it fulfils this purpose:

> I think if we look internally from a purely research group perspective, the students that we are producing on the master’s course are extremely attractive as new PhD students. They are exactly the sort of people we would like to recruit directly in our research group. (EI1.3)

Institution 2 refers to the student population the degree attracts: students who want to return to education after a break; students interested in doing a PhD but whose marks do not entitle them to a grant, the master thus becoming an opportunity to improve academic credentials; students who want to position themselves better on the job market; and overseas students.

In both cases above, the degree appears to fulfil its objectives. Length does not seem to be an issue; it only becomes one when the European context comes into play. However, opinions are split over the importance of length. In Institution 1 one respondent believes it is irrelevant, one feels uninformed to comment on the comparability of the English master, while two others state that the European norm has made them question the standard of the degree. In Institution 2 most interviewees express a preference for a two-year degree, while one declares not to have given the matter much thought, but that he would find value in a longer programme.

The shorter degree leads to several negative consequences. A one-year master appears lacking in the breadth of knowledge (rather than depth):

> Our course is just shorter, and that necessarily limits its breadth I think more than its depth (...) Students know the areas they they’ve studied very well and

> they learn a lot of stuff. But maybe the breadth of our courses is not quite so comprehensive. (EI1.4)

…and in research and independence skills students develop in a shorter research project:

> you have to give them a lot more guidance and hold their hand a little bit more through the process, because it has a much more fixed time window, so there's a lot less opportunity for the student to find their own way and make mistakes and follow a wrong path. (EI2.4)

Students' ability to make an informed choice whether or not to pursue a research career is also an issue of concern in the one-year degree:

> ...people, if they are doing a one-year master's, they have to apply for a PhD in the spring generally and they might accept the PhD place before they've really tried out doing serious research in their project because the project is mostly in the second half of the course. So a two-year master's would give them more of a taster of doing a research project before they decide on a PhD place. (EI2.2)

Apart from these pedagogic arguments, maintaining the English master's reputation is another concern. A respondent tells anecdotal evidence of graduates from his institution who were required to complete a master project in order to be able to enrol onto a PhD programme abroad. He expresses frustration at the institution's claims of equivalence between the master in England and the master degree elsewhere in Europe. He describes the institution's attitude as 'dishonest':

> It wants to preserve its reputation as being a good place and giving high quality qualifications which are, as it were, valid throughout Europe. But in order to achieve that it doesn't want to change the existing structure. So it doesn't want to put on two-year programmes because it would be expensive and the funding for the students would be problematic. So it doesn't want to do that, but it wants to present what it's doing now as being good enough. And I don't think it is. I think it's dishonest to present it as if it is. And I think we'll be caught out. I'm being very frank with you about it. (EI1.1)

He goes on to explain that the one-year stand-alone MSc was designed as a genuine master programme to compensate to some extent the gap between the integrated master and European masters; however, he would prefer a move to two-year programmes:

> I think the Physics master's programme – this was specifically why I wanted to introduce it – the physics master's programme does help, because it is genuinely 90 ECTS after the bachelors, whereas the MSci is only 60 after the bachelor (...) and it gives the students the experience of three months full-time in a lab, which I think is an important part of the master's training which is really absent in the MSci because it's not full-time (...) So I think that goes part way towards making that more satisfactory, but that's why I would prefer that we did a two-year programme because then we would be seen as being equivalent to other places. (EI1.1)

Institution 2 has actually set up a two-year EuroMasters programme[12]. The one-year master is portrayed as 'an interim solution to the situation as is', to compensate for the lacking integrated master whose equivalence is questioned. Thus the EuroMasters arose out of dissatisfaction with the status-quo, but it is reported to have had a negative reception in the UK:

> ...we've introduced the two-year master's so that we can get them a more solid foundation and also to give them more time for research projects (...) But of course some people in the UK don't like that because the official statement is that the integrated master's that UK students get in four years should be equivalent to the 3+2 Bologna model done elsewhere in Europe. And that is difficult to believe. (EI2.1)

The IoP representative confirms the existence of concerns in institutional circles, especially in scientific areas. He highlights a tension between the official version stressing compatibility and the academic position which, in his view, accepts the official version for reasons of complacency and to avoid a reputational damage:

> …we sort of muddled along and ended up (...) with the situation whereby it is pretended that the four-year integrated master's, and indeed the one year

[12] The Euromasters is offered by seven universities in the south-east of England forming the SEPnet consortium.

> stand-alone master's degrees, are the equivalent of a two-year Bologna-type master's. So that's the official story, and many people in universities are perfectly happy with that because it means they don't have to do anything, but I think it's probably fair to say that no one believes it. (Peter Main, IoP)

Thus a dilemma emerges about the way forward so that the degree will continue to meet multiple student market demands. On the one hand, for some students (British and overseas) a one-year master is fully acceptable; besides, a two-year programme would imply double costs both in fees and maintenance. In British currency one year is legitimate, reflected in the continued demand for master degrees apparently fulfilling their purpose:

> ...the evidence is we have one year MSc programmes and there are still students, they are taking them, students are still moving on apparently successfully from it. (EI2.4)

On the other hand, universities aim to attract students from other EU countries as well, and the one-year master risks not enjoying recognition in continental Europe. Hence the existence of two parallel degrees in one university already, a one-year MSc and a two-year EuroMasters, and the prediction in the other university that they will also end up with parallel offers:

> My worry is just that our master's may not be seen to be as good as from other places. On the other hand, for students who are going to stay in the UK it is perfectly adequate. So what you don't want to do is to put on a two-year programme and students look at it and say 'well, I don't see why I should do two years at [institution] when I could do the same thing for one year elsewhere'. So that's our dilemma: putting on programmes which are attractive to UK students who want to stay in the UK and also attractive to students from here or elsewhere who want to go to Europe – which is why we may well end up with a mixture of different programmes. So we might end up with a 2-year master's, maybe with a different title, to distinguish it from the 12-month programme. (EI1.1)

Lecturers' accounts therefore suggest that a perceived need of alignment with degrees in Europe competes with arguments claiming the fitness-for-purpose of the one-year degree. This seems to enjoy acceptance in isolation only, in the context of UK HE.

6.2.3.2 Purpose

In both universities there is unanimous consensus that the master prepares students both to continue their education (PhD) and for the job market:

> …in fact it's quite a useful recruiting opportunity to be able to lecture to them and to teach them. So I've had a number of cases where the students I have supervised for the summer projects have ended up being my PhD students. And also we are aware that many of them want to go into industry or finance. And so I do try to highlight, you know, commercial aspects of the material that I'm teaching. (EI1.2)

The way of thinking and skills students develop while studying physics, i.e. independence, analytical, problem-solving skills and so on, are deemed to make them suitable for both a PhD and a job elsewhere.

However, in Institution 1 there is agreement that many master students will probably do a PhD. This is related to the pronounced research dimension discussed later on.

6.2.3.3 Relationship with bachelor

Only Institution 2 lecturers discussed the master's relationship with the bachelor. The master emerges in most accounts as the degree which makes students fully-fledged professional physicists. Undergraduate studies are deemed too short for this, as reflected in the chosen career paths of bachelor students, not necessarily in physics:

> I think that an undergrad is very much prepared to do anything, right? But if you really want to use physics as a career you have to do that little bit extra, so you either do an MPhys or an MSc. (EI2.4)

As one lecturer explains, since the undergraduate degree is often an exit degree in the UK, it aims to give students the 'average knowledge' of a physicist. It thus goes into some advanced subject matter to the expense of basic physics areas which are overlooked. This contrasts with practice in other European countries where there is no assumption that a three-year degree can offer a rounded physicist training. It thus concentrates on giving students basic knowledge to be topped up with a master:

> But we assume that with a BSc people will have a more or less average knowledge of the area of physics. And in order to do that, you have to cut some of the basic stuff to put in some of the slightly more advanced stuff that you expect a physicist to know (…) So the typical structure on the continent is you do sort of generic experimental physics in the first year, a little bit of everything, then you do a more theoretical description in your second year of the classical part of physics, and in your third year you go into more advanced, but still basic physics like quantum mechanics. And then you go to advanced applications like condensed matter physics, nuclear and particle physics. What we do in the UK is we cram the mathematics you need and some of the basics into the first year, we teach what continental universities teach in the third year in the second year, for example quantum mechanics and statistical mechanics, and then in the third year we put in the more advanced stuff, but sort of basic knowledge of a physicist, like introductory condensed matter physics and nuclear and particle physics. (EI2.1)

As a consequence, the UK master is portrayed as a remedial degree, making up for the shortfall in basic knowledge rather than addressing advanced areas in depth:

> That means that at MSc level you're sort of patching things together because you've never taught the foundations. So you put in a little bit more foundations that they should actually know, but you don't have the time at the MSc level to go into more detail because you can't spend a whole lecture course in theoretical mechanics that you would actually have to understand in detail before you do quantum theory or quantum field theory. (EI2.1)

The master thus emerges as the fundamental level of a physicist's training, even though the bachelor aims to deliver 'average knowledge'. The bachelor does not appear as sufficient preparation for a physics career.

6.2.3.4 Student competences

The one competence that permeates all lecturer accounts in both institutions is students' ability to undertake research (understanding research issues, how research is conducted, and the ability to undertake independent research by the end of the master):

> I think the main requirement for a master student would be that they are ready to enter a PhD programme (...) so this is off the top of my head, but I think they need to have research skills so that they know what to do when they enter a PhD and they are expected to go into research, so they would know what sort of background reading they should be doing, how they should be organising their time, how to plan a project, that sort of thing. And also obviously when it comes to it to be able to write an account of what they are doing. (EI1.1)

In addition to research skills, one student characteristic invoked unanimously in Institution 1 and by most lecturers in Institution 2 is advanced or specialised knowledge of a specific area:

> …it can still be a particular research direction, like for example atomic and molecular physics or experimental particle physics (...) but in that particular area [the student] should be capable of coping with advanced material and then show appropriate knowledge and skills. (EI1.1)

Breadth of knowledge is invoked, too, alongside advanced knowledge by about half the interviewed lecturers.

Independence appears in most accounts as a competence master students should develop. Motivation is also present to some extent. Quite surprisingly, problem-solving only appears in three accounts as a skill students are expected to develop. Communication skills are mentioned once only.

6.2.3.5 Research dimension

In both institutions, elements indicative of the degree's research focus are: the research project; emphasis on the development of research skills (as above); students' induction to research work practices (for example, both institutions speak of research-oriented assessment practices); integration in a research group during the master project; and the master as a stepping stone to the PhD. The following statement is illustrative:

> ...the assessment exercises on our research projects very much mirror what you do as an academic. So there are poster sessions, there are vivas, there are presentations, there's people looking over your shoulder, continuous assessment... Of the sort that would happen to you if you were an academic and you had to stand up in front of an audience. (EI1.3)

In addition, in Institution 1 the research dimension is strengthened by a compulsory course in research skills; a mini research project based on a literature review; and exposure to real-life research through participation in research projects carried out by staff. Institution 2 mentions informal research seminars.

As mentioned earlier, the master is on various occasions portrayed as a 'stepping stone' towards a PhD, evident in the emphasis on students' acquisition of research skills and their socialisation into a research environment. However, especially in Institution 2, it is in preparing students to become qualified PhD students that the one-year master appears lacking:

> What I would expect from a student at the end of a two-year master programme is that once you've got your one year in which you are completely dedicated to your project, at the end of that year you are already a PhD student, right? This is not true for all the master students in the one-year programme. (EI2.3)

Three aspects are coming together from the above discussion: the purpose of the master, its research dimension and the length of the degree. Together they lend themselves to a tentative proposition. Despite apparent agreement that the master's purpose is to prepare students for both further study and work, the degree as preparation for a PhD (or a research career) seems to weigh heavier in teacher accounts. The preoccupation with students' research skills and the master as induction to research are illustrative. Moreover, it appears that it is specifically research-related aspects that lecturers believe are affected by the programme's duration (such as degree of independence within a short project, limited perspective to make informed choices on the PhD as the next step) – hence the degree only appears lacking in its ability to prepare students for further research. No mention is made of students' alleged inability to enter the job market because the master is shorter than elsewhere. Thus the timeframe seems to influence the extent to which students are able to develop research competences. Regarding the time dimension, teachers are also torn between the fitness-for-purpose of the degree in a UK context and its perceived incompatibility with the European standard, capable of affecting the degree's reputation and attractiveness. Thus, a possible outcome might be the provision of parallel degrees of different durations to cater for different segments of the student population.

6.2.4 Student conceptualisation

No major differences have been noted in the opinions of students from the two universities as regards the degree dimensions considered in this chapter. Where such differences exist, they will be highlighted.

6.2.4.1 Structural aspects

With one exception, all students criticise the intensity of the degree and its compression within one year, using words such as 'rushed' and 'crammed' to describe it. Several areas are negatively affected. First, there is dissatisfaction with the depth of engagement and understanding of course material. One student believes that the accelerated rhythm of courses does not allow time for reflection around what is being learnt:

> I found myself doing the work I needed to pass the course, instead of doing the work I needed to completely understand. You know, there's a difference between doing all the work in the course and having a little bit more time to do extra work that you're interested in. I think the taught component of the course has been just the right amount, any more and I would have started to feel like I've had enough of exams (…) so maybe just spread the courses over one extra term or something like that. And then to be given more practice examples and stuff like that. So not to make it any easier, but just to have more time to really understand what's happening. (EI1.1)

Second, the duration of the project gives no leeway for things to go wrong, which can be problematic when experiments are involved, as in physics research:

> I feel that the project might be a bit rushed because sometimes you can't predict how long the experiment will take (…) sometimes you need more time because in experiments you can't expect everything to run smoothly, because

> sometimes you experience something which is not working, so it might take a long time just to do a project. Compared to other subjects where the dissertation is like reading from books and analysing the data, for us we have to carry out the experiment, and then get the results, and then we can start writing up. (EI2.1)

Third, students experience their decision about the next step, i.e. PhD, as an insufficiently informed choice. They must apply in winter before having experienced the whole variety of possible areas and identified the topic of most interest. Besides, at the time of the application they will not have engaged with research yet – hence no certainty that this is what they want to do next. Moreover, confidence about their level of preparedness for a PhD can also be low, since applications occur at a time when students still make sense of what they are learning:

> ...because it's only one year, you start doing your courses and I didn't really know what I wanted to do. And then all of a sudden I had to start picking my options, deciding what I wanted to do even before I came in. And you come to the master's to kind of expand the knowledge of physics, but by January-February you had to have applied for a PhD if you wanted to go straight into one. So I applied for the PhD before I've even done my research. So I didn't have a chance to see what that's like, if I wanted to, if I like it or not. If you want to do a PhD straight afterwards, you have to have decided your PhD after a term, it's not enough. (EI1.1)

However, one student feels it is worth the intensity, given the achievements at the end of the year:

> It does feel a bit rushed. There's a lot crammed into it, but I think it's right. The work is definitely achievable, the learning you get is fantastic, what you get from it is an awful lot in just a year's work. (EI2.2)

6.2.4.2 Purpose

The interviewed students' preferred destinations confirm the lecturer perception that students become professional physicists in the master. Only one student aims to go into a non-related sector (management), but considers maybe returning to physics later. All other students intend to pursue physics careers, three with a PhD and two in physics-related jobs outside academia.

In Institution 1 in particular, student accounts suggest that a professional physicist career is equivalent to a research career. This, however, normally requires the completion of a PhD – hence the likely necessity of pursuing a doctorate to then work within physics, although students might feel prepared to undertake research already after the master:

> *So you feel you are prepared enough after the master to go and work as a physicist...*
> Yes, but I get the feeling that a lot of employers wouldn't employ me. As in, if you apply for a research job in some field they're expecting you to have a PhD. (EI1.2)

Most students deem the master more geared towards training people for a research career. It thus appears as a stepping stone for a PhD, in turn leading to the desired physics career.

Nonetheless, one student also describes it as an exit point for an alternative career in which the skills students develop by studying physics are valuable:

> I think the analytical skills you develop when doing a physics degree are definitely useful (...) because you need to see relations, you need to maybe build a model to simulate something, so it's not directly related, but somehow it is. (EI2.3)

6.2.4.3 Student competences

When asked how they have developed during the master, all students referred to acquiring research skills and confidence in engaging with research:

> I feel like if someone was to give me a completely new subject in physics that I hadn't studied, and said 'go and do research on this', I could go out and I'd be able to learn enough by myself, and with a little bit of help I'd actually be able to do research on that. Whereas before if someone gave me something that I hadn't come across before, I'd just be completely lost. I think it has

given me a lot of confidence that I can do research and is actually what I want to do. (EI1.1)

Independence and a self-driven approach to learning is also mentioned by all:

> I think it should be more on your own. You should get more responsibility. For example the summer projects, if I don't do anything it will probably take at least two months until somebody notices (...) I think in an undergraduate degree everyone is looking at you: are you practising? Are you doing your homework? (EI1.3)

Advanced knowledge and specialisation in a topic appear in about half the accounts:

> I think an undergrad degree is more basic, you have to learn all topics and a master degree should be more specialised. And because it's more specialised, you are able to go more in depth in the topics. (EI1.3)

A higher level of understanding leading to the ability to apply knowledge in new contexts and problem-solving skills is present, too, in about half the accounts:

> In the undergraduate it was more just being able to memorise stuff and regurgitate it back in the exam and then you can forget it afterwards. Whereas this year is more about having the skills to tackle questions even if you haven't come across them before. (EI1.1)

Students also feel they have become better at learning about new areas undirected:

> ...doing a physics degree not only teaches you very hard things, but it teaches you that yes, they're hard, but you can learn them, they're not impossible. And it just teaches you to be quite comfortable with learning something very hard and not to be sort of intimidated by that. So that's what I have learnt in the masters course a lot. (EI1.2)

Motivation also appears as a quality in some accounts:

> I feel more driven, I want to do this, it's not like they are giving us work, they are giving us the exams. I'm taking the exams, I'm choosing to do it, so the

> choice aspect means that maybe I'm a bit more engaged than I was in my undergraduate. (EI1.2)

In addition, communication skills and self-discipline are mentioned by one student each as competences developed during the master.

6.2.4.4 Research dimension

The research project is unanimously mentioned as the opportunity to engage in research practices and to learn to undertake research independently. It is the aspect that stands out for students as the hallmark of master education, particularly in relation to independence and initiation to research. With one exception, all students in both institutions emphasise that acquiring research skills is more important than the project itself as a scientific outcome:

> ...in terms of what you learn, and learning to work on a project, I'm not going to say the project is irrelevant, but the actual content, and development, and success of the project are not the key. They don't recruit MSc students so they can get research done. They recruit them so that the student can learn to work on a project. So, you know, the project can be a complete failure, but so long as they've learnt and done it, I'd pass it. (EI1.2)

> I think definitely the training that it gives you is more important for the master's than getting an original piece of research, because that's more the focus of a PhD. It would be more the skills that you developed to actually be competent in a laboratory. (EI2.3)

The confidence of having developed research skills comes across in students' answers regarding competences acquired during the master (see above).

If learning to conduct research (acknowledged by all students) were the only intended outcome of the project, its time-span would be less important. Nonetheless, particularly students in Institution 1 highlight the benefits of a longer research project. One considers it would benefit students interested in a PhD, because they will have already applied their research skills in an exercise closer to a PhD project:

> It's better to do a nine-month project before starting a PhD because you will learn about planning, you will learn about forging a big thesis up after nine months compared to three; of course that's a big difference. And I know at least if you want to go to another field than PhD, for example to companies, I don't think it's a big difference. I think the main difference is whether you want to do a PhD. (EI1.3)

Another student is concerned with the value of the project as a scientific output, thus resenting the short time allocated to it:

> I would have preferred it if the research was a bit longer. I see no reason why we can't then do six or eight months of research. I feel a little bit rushed, you know? (…) Three months is enough to really get going, but it's not long enough to do like a nice piece of well-rounded research that's really useful. (EI1.1)

Therefore, opinions vary over the degree of involvement with research in the thesis and the outcomes students envisage as a result. They range from the project being an exercise meant to develop research skills (acknowledged across the board), to the project as an opportunity to develop research skills and apply them to a longer piece of research, and an opportunity to produce research that is a useful contribution to science (especially in Institution 1).

In addition to the master project, students in Institution 1 describe two other instances of research training: a research skills course:

> ...where I learned more about how to construct an experiment, how to think about how you might design your experiment (EI1.2)

...and a literature review aiming to train students in bibliographic searches and presenting information on specific research topics. In Institution 2, however, student accounts suggest that they only engage with research practices during the thesis, and not through the courses.

Students in both universities have experienced the master as apprenticeship and gateway to a professional physics career. However, as mentioned earlier, the perception is that a PhD will be necessary to legitimise a professional physicist:

> It would sound awfully arrogant of me to say ‘yes, I’m a professional physicist’. I feel like a physicist. As a label, that’s what I am, what I’d like to be. I just don’t necessarily have the qualifications to prove that, i.e. a PhD. (EI1.2)

In summary, students generally see the master as a degree which opens the door to a professional physics career, as demonstrated by their destination choices. Especially in Institution 1, a physics career appears equivalent to a research career; to embark on it, however, a PhD is perceived as necessary. Across both institutions, students believe that the master is predominantly geared to prepare students for a research career, acting as a springboard to a PhD. Among the competences that all students feel they have developed are research skills and independence in learning. Advanced knowledge, problem-solving ability and knowledge application are mentioned to a considerable extent, too. In both institutions the thesis is the primary means of research training. Besides, in Institution 1 there are other activities with pronounced research focus. An outstanding aspect is the fact that students emphasise the learning of research skills as the main outcome of the thesis rather than the production of a useful research output. Nonetheless, some students see value in a longer project: it would allow thorough application of their research skills, as well as result in ‘useful’ research. A general opinion emerges that the degree is rushed, with some negative consequences: the depth of understanding in the courses is limited; the short time for the thesis does not allow things to go wrong; and it is difficult to make informed decisions on the next career step, i.e. PhD. Criticisms related to length thus appear to address mostly research-related aspects.

6.3 Portugal

As mentioned in the previous chapter, Portugal passed legislation to establish new degrees aligned to the Bologna recommendations. After the changes to the Portuguese degree framework, the master appears to have replaced the *licenciatura* as the qualification enjoying recognition and esteem among academics and students. This section focuses on the understandings and re-conceptualisation of the master further to the implementation of the new degrees in Portugal at national/political level, in academic circles and among students.

6.3.1 National/political conceptualisations

6.3.1.1 Structural aspects

Law 49/2005 (MCTES, 2005) amended the Basic Law of the Education System (Law 46/86) in order to provide the legal basis for the introduction of degrees aligned to the Bologna cycles. It replaced the four academic degrees (bacharelato, licenciatura, master and doctorate) with three (licenciatura, master and doctorate). Decree-Law 74/2006 (MCTES, 2006b) then approved the organisation of higher education into three cycles defined by student competences based on the Dublin descriptors and by credit ranges.

Law 74/2006 makes reference to the Bologna Process in the very first paragraph: a government priority between 2005-2009 is 'to guarantee the qualification of Portuguese people in the European area, implementing the Bologna Process, a unique opportunity to promote higher education attendance, improve the quality and relevance of the courses offered, encourage the mobility of students and graduates and the internationalisation of the courses'. Thus the three-cycle system established by law is explicitly linked to the implementation of the Bologna Process, a window of opportunity to address issues such as recognition, participation, quality, mobility etc. As several national interviewees underline, the degree reform and the shortening of studies was a means of facilitating the access of more students to HE, for instance as stated by the Secretary of State: 'to enlarge the recruitment base, we still have few students in higher education, we need more students'.

The law stipulates in detail the conditions applying to the provision and awarding of degrees. Regarding the master, it regulates the following aspects:

- Student competences as described in the Dublin descriptors
- Conditions awarding institutions must fulfil, i.e. qualified teaching staff; human and material resources; the standing of their training, research or professional activities (assessed during accreditation)
- Access and entry conditions
- Credit ranges between 90-120 credits lasting between three to four curricular semesters of student work; however, it may include 60 credits lasting for two semesters 'following a stable and internationally consolidated practice in that

specialist field' and 'exceptionally and without prejudice to satisfying all of the requirements related to the aims of the degree'.

- Weight of taught component and dissertation
- Supervision
- Assessment by a jury
- Final classification.

In addition to the stand-alone master degree, the law approves the integrated master. It can be awarded after an integrated cycle of studies of 300 to 360 credits, normally lasting between 10 and 12 curricular semesters. Duration is established by EU legal standards or by consolidated practice in a profession within the EU.

Besides, the Framework for Higher Education Qualifications in Portugal (FHEQ-Portugal) (MCTES, 2009a) signals the master as a discrete qualification, corresponding to a second-cycle qualification in the FQ-EHEA.

According to the national report for Portugal drafted for the 2009 Bologna ministerial conference, in 2008-09 about 98% of Portuguese degrees were already organised according to the three-cycle system (Direcção Geral do Ensino Superior, 2008, p. 9).

The structural changes affecting the degree framework, particularly the reduction of study years, have triggered a shift in perceptions of the purpose and standing of the master. The next two sections will address this.

6.3.1.2 Purpose

Three purposes for the master, materialised in three types of degree, emerge from legislation: academic specialisation, professional specialisation, and master facilitating access to a profession. First, Decree-Law 74/2006 distinguishes between university- and polytechnic-awarded master degrees.

The university master envisages academic specialisation and research: it 'must ensure that the student acquires an academic specialisation with recourse to research, innovation or expansion of professional competences'.

The polytechnic master emphasises professional specialisation: it 'must ensure predominantly that the student acquires a professional specialisation'.

In addition, there are integrated masters (offered in universities only) facilitating access to practice in an established profession.

National level interviewees describe the master as a vague qualification with blurred identity and purposes. It might be the clear purpose of the previous master, perceived to have had a pronounced research orientation, which explains the current perception of fuzziness. The current master degree can be equally a professional degree and an academic research-focused one; it can complement the first cycle to ensure an adequate training level, or it can be an initiation and springboard to research, as Pedro Lourtie, former Secretary of State, describes it:

> I would say that the master is not one thing. It's several things, in fact. It's a sort of complement to the first cycle for areas where the first cycle is not long enough to prepare people for a job: engineering, architecture, medicine, dentistry, things like that. So there the master is a professional degree. Or in the cases where you have a first degree in other areas, it could be more like an academic master that sends you in a way to do research. (Pedro Lourtie)

The current Secretary of State for Higher Education underlines the wider purpose of the master in the society beyond its strictly professional or academic specialisation role. He describes it as a key component in the government's lifelong learning agenda, allowing people to re-train throughout their professional lives in a fast-moving economy requiring flexibility and career changes:

> We see the second cycle very important (...) to really implement a lifelong learning strategy for society at large so that people can come back to the institutions to re-qualify and qualify in different areas. Life is changing at a fast speed and everyone, almost everyone, ends up by doing things they were not initially trained for. So people need to come back and specialise, some of them do PhDs, others do masters. (Manuel Heitor, MCTES)

6.3.1.3 Relationship with the bachelor

The equivalent of the bachelor (the first cycle) in Portugal is the *licenciatura*. As mentioned earlier, perceptions of the master degree have been influenced by the re-organisation of the degree framework into the three Bologna cycles and the changes affecting the undergraduate degrees. In the previous system polytechnics could offer a three-year *bacharelato* followed by a second cycle leading to the *licenciatura*, while universities could confer a *licenciatura* after four (e.g. sciences), five (e.g. engineering) or six (e.g. medicine) years. In the new Bologna structure, the three-year *bacharelato* disappeared and one undergraduate degree only was preserved. The chosen designation for it has been *licenciatura*, awarded after three years in polytechnic education (exceptionally after four years) and three or four years in universities.

The naming of the first cycle has caused debate, being accused of misleading people to believe that the new licenciatura corresponds to the old licenciatura. However, there is consensus that the reduction in study years makes the equivalence unfounded. The same applies to the equivalence between the new master and the old master. There is a perception that the old degree framework has shifted one level down, with the current master being equivalent to the old licenciatura. In contrast to the previous perception of the master as an advanced postgraduate research-heavy qualification, it now appears as fundamental training replacing the former licenciatura as the degree which enjoys recognition and esteem:

> ...the first cycle is losing as a recognisable qualification at European level. People look at the first cycle as something you do before the master. So the master becomes, has become, these last ten years, the main qualification to go around in Europe in fact. And this means that the characteristics of the master have changed from a postgraduate to a normal graduation. (Pedro Lourtie)

However, interviewed national representatives stress the need for open-mindedness in academia and society to understand the changes. The new degrees are different in nature and purpose from the previous ones, so one should not view them with preconceived ideas and expectations based on the previous degrees. However, a widespread change in perception and an un-biased understanding of degrees takes time to occur in the public opinion:

> People have a conception of what an engineer is, I guess. That changes with time, but to say that from now to tomorrow I'm going to change, it's very difficult for people to do. And that's not only engineering, of course. That's why the Bologna squeeze, when you try to put four years into three, because you are not able to look at a three-year programme as something that, well, it's not exactly the same thing as the four-year programme that we had before. It's something different, you have to think independently from what we had before. What can I achieve in three years? What can I do in three years? You know, it's thinking in a different way. (Pedro Lourtie)

The lack of a recognised national qualifications framework at the time of the interviews is criticised by two respondents as hindering the description and understanding of degrees. It is worth mentioning in this respect that the Secretary of State believes the biggest challenge in the implementation of Bologna has been for institutions 'to understand the difference between the first and the second cycle'. This will be further addressed in section 6.3.2.

6.3.1.4 Student competences

Law 74/2006 and the FHEQ-Portugal lists the student competences associated with the master degree. They are a direct transposition of the Dublin descriptors, covering the same areas mentioned in section 6.1.4.

'A Masters degree is awarded to those who demonstrate that they:

a) Possess such knowledge and capacity of understanding that:

i) Based on the knowledge obtained in the first cycle, they manage to develop and expand that knowledge;

ii) Manage to develop and apply that knowledge to original situations often in the context of research;

b) Know how to apply their knowledge and understanding and problem-solving capacities to new and unfamiliar situations in wide multi-disciplinary situations, although related to their area of studies;

c) Possess the capacity to integrate knowledge, deal with complex matters, develop solutions or put forward opinions on situations of limited or incomplete information, including reflecting upon the implications and ethical and social responsibilities that result from both those solutions and opinions or indeed that condition them;

d) Are capable of communicating their conclusions and the knowledge and reasoning that underlie them, both to experts and non-experts clearly and unambiguously;

e) Possess learning competences that will enable them to benefit from self-oriented or autonomous lifelong learning' (MCTES, 2009a).

What therefore stands out are: advanced knowledge and potential for originality, knowledge application, dealing with uncertainty and complexity, analytical and critical thinking, communication skills and independent learning.

As to opinions expressed during interviews, national level participants all refer to independence as a competence that should characterise master students. Independence is described with respect to two dimensions: an independent style of studying and independence in defining and pursuing interests:

> …a master degree holder should become, I wouldn't say completely independent, but really autonomous in the capacity to look into a problem, formulate a problem, exploit and explore what was being produced about that problem, and then being able to synthesise that and to see beyond. And at the end, when you look back, you say: ok, now I understand it, where do we go from here? And am I able to take my own steps? Am I able to choose what kind of direction I want? (Bruno Carapinha, Student representative)

The ability to apply knowledge in new situations and confidence in tackling and solving new problems is mentioned in two instances:

> I believe that the master gives you an added capacity to tackle complex problems and new problems compared to the first cycle – as simple as that. (Sebastião Azevedo, BFUG)

The master as an instance of specialisation is referred to twice as well:

> I see that the main issue is to facilitate the specialisation of knowledge in a given topic, while the first cycle should be a broader view of many topics that

> can have impact in better understanding the issues of the professional life; while in a master you should go specific in a topic. (Manuel Heitor, MCTES)

Surprisingly, as to research, there are only two references both portraying the master as research induction. It can be speculated whether the low emphasis on research is due to the earlier-mentioned perception of a diluted research dimension of the master. It is also likely to be a result of the massification of the degree and the difficulty of providing in-depth research training to large student numbers in a context of unchanged academic resources.

6.3.1.5 Research dimension

Decree-Law 74/2006 regulates the weight of research in the master, stipulating that the degree must have 'a scientific dissertation or an original work project' or 'a professional work placement which is to be concluded with a final report', corresponding to a minimum of 35% of the total number of credits. In the case of the university master – the object of this work – an academic specialisation must be acquired 'with recourse to research'.

One student competence makes reference to knowledge development and application 'to original situations, often in the context of research'. As shown above, research skills are not standing out among expected competences. Instead, the master is described as initiation to research. This contrasts with the old master considered as a qualification with a strong research dimension.

Summing up on the national perspective of the master, legislation has established the degree as a Bologna second-cycle qualification. Conceptions of its nature and purpose seem to have shifted further to the shortening of undergraduate education and the master's massification. Whereas previously the master appeared as an advanced research-intensive qualification, it is now perceived as a fundamental level of university education, either in an academic or a professional field. It does not appear to have a clear identity, but in the political arena it emerges as a key tool to support the lifelong learning agenda and to align higher education to economic and societal needs. Accounts point to poor understanding of the new degrees in academia and in the society and to the anchoring of opinions in the previous system. Among competences expected of master students, the following stand out: independence, knowledge application and confidence in tackling problems, specialisation. Research skills do not emerge strongly, probably given the weaker research orientation of the master further to massification. However, legislation stipulates that in an academic master research should amount to over one third of the degree.

6.3.2 Academic conceptualisation

Differences mainly related to research aspects have emerged in the accounts of academics in the two master degrees considered in this study. Academic understandings are presented in one integrated account, but differences are highlighted whenever they exist.

6.3.2.1 Structural aspects and relationship with the bachelor

Academics in both universities have similar views about the master: the new degree is seen as a hybrid qualification between the old licenciatura and the old master, resulting from an adaptation of the two. Thus, teachers often talk about the 4th and 5th years of study in the previous licenciatura when referring to the current master – indeed, it appears they equate it more with these final years than with the previous master:

> Do you want to compare with the master we had before or with the 4th and 5th years of study? Because that's different. It's master compared to master? What was a master before or what was the fourth and fifth year and now it's called master? The old master was after at least four years, or sometimes five, so it was more advanced. (PI2.4)

Nevertheless, in terms of expectations teachers compare the current master with the previous one. Reference is repeatedly made to duration and how a reduction in the undergraduate years has had the following effects:

- lower level of knowledge on entry resulting in less advanced master courses
- reduced scope of the thesis (less than one year as in the old master)
- more modest expectations of student achievement on completion.

The following paragraph summarises the perceived losses further to a shorter licenciatura and the massification of the master:

> ...because now students only have three years behind them before enrolling in the master, they have lower knowledge than they used to. And therefore from what we used to look at from a master student at the end, they can't produce as much as they would be expected to do before. And so I think the master is going to be easier to obtain, in that sense. It doesn't mean that they don't have to work as hard, but we cannot expect them to reach the same level. And that's a natural thing, they have one year less behind them, and that they have to somewhat compensate in the first year of the master, which means that they are not going to have courses that are as demanding or as advanced as before. And even the thesis which was a full time thesis for a year before, now at least during one semester in the last year is accompanied by courses as well, so they cannot dedicate full time to thesis. (PI1.1)

A shared perception emerges that the master in physics now corresponds to the previous licenciatura, representing the fundamental level of physics training. It is the default degree enjoying recognition on the job market. The current licenciatura is deemed insufficient preparation for a professional physics career:

> I think the student finishing with the master degree is going to be the rule, I don't believe that there are students who actually finish their first degree and immediately go to look for a job (...) the ones who really want to do physics they really have to go through a master degree. I think that in practice it would be the first requirement to be a professional physicist (...) Maybe in informatics or other topics, more applied ones, maybe they can go for a job immediately after the third year. (PI1.2)

The concern with misleading degree names is apparent in both institutions. Designations are accused of incorrectly implying equivalence between old and new degrees:

> I think the choice of names was rather unfortunate, at least in this country, because basically what you're doing is giving a degree the same name, which must be easier to get because you just have less time to work on it. (PI1.1)

However, positive consequences of the master degree now starting earlier are identified, too, differences emerging between the two HEIs. In Institution 1, upgrading the fourth year of study to master level presents a well-founded justification for higher level teaching and increased demand of student effort earlier than previously. A selection has already taken place, meaning that the calibre of students is high and that these have made a conscious choice towards a physics career. The two cycles signal a formal demarcation:

> ...this is a new stage, this is a new beginning. This creates some kind of difference in the understanding of the position where students are, that they are doing a new step. (PI1.6)

> I usually say that we had one opportunity. The fact that the 4th year is now a master degree allows, let's say, a rate of teaching and demand that you couldn't have in the fourth year of your final degree. So these students already have a degree, they are going up to a master, so they really want to do something and they have ambition of a physics career, so they have to have good grades...And so that population has already been selected in the 4th year. (PI1.5)

In Institution 2, however, the benefits of an earlier start on the master are earlier contact with research and increased emphasis on knowledge application. Whereas before students acquired vast amounts of knowledge and only afterwards embarked on research and applied it (i.e. knowledge acquisition followed by knowledge application), they now start doing research while still gaining knowledge (acquisition and application are simultaneous):

> ...they are collaborating in research activities, maybe with less knowledge than in the past. So they are learning at the same time that they are doing research. In the past it was a little bit different. It was more theoretical. People were trying to learn as much as possible before applying the knowledge, and now it's not the same. (PI2.5)

Nevertheless, teacher accounts in both institutions also reveal that the old master was not a common degree, neither a pre-requisite for a doctorate nor for securing employment. Employers recognised the old licenciatura, and students could also start a PhD straight after it. Not many people would choose to enrol in a master, also because the fees are reported to have been high. The purpose of the old master does not emerge clearly in the interviews:

> The old master, only very few people were doing it, there were not so many opportunities for the master in the past, you had to pay, the fees were very high. (PI2.5)

Thus, a tentative proposition could be that the status-quo in terms of structure has been maintained, with one degree only, both in the past and at present, seen as the fundamental educational level and the stepping stone towards either employment or PhD. Nonetheless, compared to the old licenciatura, the master now enjoys a higher rank of esteem, incorporating elements of the old master as well, especially higher level teaching and earlier engagement with research. It remains to be seen whether the new three-year licenciatura will gradually gain more acceptance and the master will achieve a distinctive identity as an advanced postgraduate qualification. It is worth mentioning here that the PhD too has undergone changes. As opposed to a research-only degree in the past, it now includes a taught component to compensate for the perceived deficit in student preparation.

6.3.2.2 Purpose

Both Physics MSc programmes are targeted at a research career, either through a PhD or research-related jobs in companies, such as R&D work:

> The master we are talking about is a master which is quite directed to research (…) One big thing for the students who finish the master will be to then continue and go into research, PhDs, both in theoretical physics and experimental physics. I think also – and this is already happening, mostly with the experimental guys – that they can go and work in companies that do R&D, technology companies, and there are some students who already went. If there are more companies around, that will happen more. (PI1.4)

Institution 2 offers another degree, Physics Engineering, geared to employment. The Physics MSc's orientation towards further research explains a noticeable focus on activities which facilitate students' preparation as researchers:

> …here if a student follows a master in physics, he's much more trained to do research, but not exclusively at university. He can do research at some company if he's lucky to find some company, but always to study, to be able to look for literature, to be a researcher. (PI2.4)

Teachers also discuss the nature of the discipline and the profile of a physicist as a very adaptable individual, capable of applying the skills learnt during his/her studies to different areas. Physics is portrayed as a way of thinking and acting characterised by logic, a problem-solving attitude, capability of applying knowledge in different contexts and facility for understanding and learning new things. This opens up a wide range of possibilities for physics graduates:

> One of the things that I value more about the training of someone in physics is actually the ability to learn. He has a fundamental set of tools – analytical skills, a bit of computing skills, a bit of mathematical skills, the training in the knowledge of doing concrete things with those tools, and these general problem skills, I think, the ability to learn, to go into a different subject sometimes, and think about that subject using the kind of modelling that eventually he was trained in in physics. (PI1.5)

6.3.2.3 Student competences

The student competence which receives weight in all teacher accounts is the skills necessary to undertake research, such as searching for literature, making critical judgements, synthesising information and so on:

> ... they should be able to read, to get a good grasp of the literature, to read papers and take conclusions out of there. If they are theory students, they should be able to reproduce calculations that they find in these papers (...) We would like him to be able to do a very decent writing of a summary of something that he has read and studied for a certain time. So these are, as I mentioned, reading and understanding a paper, being able to do a survey of literature and writing a good summary on it, being able to reproduce some of the calculations he finds in the papers. It's mostly, if you want, research capabilities that we are talking about. (PI1.5)

The other two competences expected from master students mentioned in both institutions are advanced knowledge and specialisation, and independence. However, specialisation and advanced knowledge in a particular area appear to weigh more in Institution 1:

> it would be a specialisation towards one particular area in physics where he would achieve a knowledge that is reasonably well advanced. (PI1.1)

...whereas independence is unanimously mentioned in Institution 2 and only by about half the teachers in Institution 1:

> They should be able to do some work by themselves and to look for other problems, for other ways of doing things, not so much oriented work, but a more autonomous way of working. I think this is the main difference between an undergraduate and a master student. (PI2.3)

In Institution 2 academics seem to place quite a strong emphasis on communication skills – rather unusual given the relatively low importance assigned to this skill in the other HEIs in this research (in Institution 1 communication skills are only mentioned by one respondent).

6.3.2.4 Research dimension

The student competence most valued in both programmes is research skills:

> ...our standard in preparing students for a master in physics has been the capability of these students to do well in programmes outside Portugal in respectable and well-considered research centres in universities. (PI1.5)

A difference becomes apparent in the means employed to give students research training. In Institution 1 the thesis emerges as the main opportunity for students to dive into research and engage with typical research tasks:

> ...reading literature, reading and working out papers and being able to present their papers…the bulk of that occurs during the thesis work, but it also occurs during subjects that people can teach. (PI1.2)

There is also a tacit expectation that a published paper will be the outcome of the thesis:

> …with the thesis work, although it was not formally required, at least in some areas of the department it would almost be expected that with this work, with this thesis, a paper would be the result. (PI1.1)

Other aspects facilitating exposure to research are the inclusion of research perspectives in teaching, i.e. researchers carrying out teaching based on their research and bringing latest knowledge to students:

> I think that research should always be on the ideas that we put in the class and put in the work with students. So I always focus on that. Something I try to do, I always do some kind of PowerPoint presentations bringing the current research issues there, so again they will have an overview of what's the research in this area. (PI1.6)

...and collaboration with research institutes for students' practical preparation:

> … now the research institutes are engaged and responsible also for the course (...) Then when we have classes of high level, as the department has no equipment for this kind of things, we use the research equipment from the institutes. (PI1.3)

In Institution 2, in addition, the research dimension of the master is evident in teachers' preoccupation to familiarise students with research work practices already during the taught part of the degree (i.e. literature searches, synthesising information, data analysis, experiment design). Project-based learning, research tasks and presentations during courses reflect a concern with progressive student induction to a research environment. Thus, by the time of the thesis, a student should already be able to:

> ...on his own research, search papers and articles about the topic, to compile info about that, and with of course some orientation, to carry out basic first, but then more specialised research on that topic (PI2.1,2)

In summary, teachers describe the current master degree by reference to the pre-Bologna qualifications. It has been downgraded compared to the previous master and corresponds to the old licenciatura as a physicist's basic educational level, enjoying recognition on the job market – hence the disagreement with the choice of degree names. As to student preparation, it is however superior to the old licenciatura. Its identification as a second-cycle qualification justifies more demand on student effort and a higher level of teaching. It is also an opportunity to familiarise students with research early on. Thus, regarding educational level, the master appears to sit in-between the old licenciatura and the old master. Both physics master degrees aim to prepare students for a research career, whether in academia (through the pursuit of a PhD) or in industry. Research training is approached differently in the two institutions: in one mainly during the thesis, while in the other it already occurs during the taught part of the master. Acquisition of research skills is given high importance in both institutions. In addition, advanced knowledge and specialisation and independence are considered essential student competences at master level. Surprisingly, communication skills emerge to some extent in one institution.

6.3.3 Student conceptualisation

6.3.3.1 Structural aspects and relationship with the bachelor

Students speak little about the structural aspects of the master, probably because they have not experienced both pre- and post-Bologna degrees, as in the teachers' case. However, in Institution 1 most students experience the master like a continuation of the bachelor and feel that the first year is identical to the bachelor, except for the level of difficulty:

> Until the fourth year, the first year of the master, it isn't much different from the undergraduate course. It is a little bit harder, that's all. (PI1.3)

In Institution 2 this view is shared as well to some extent. One student, moreover, criticises the perceived loss in the weight of research and the evolution of the degree from a research one to a taught one:

> Right now the first year of the master degree is just an extension of the bachelor – they are called licenciatura here – but they were 4-5 years long, and now they are only three so the master degree right now is just a continuation of the bachelor to have the full five years. So it's more like a taught degree. I think that before it was more like a preparation to do a PhD than it is now. (PI2.1)

Indications exist therefore of the student perception that the master is an extension of the first cycle aimed at compensating the new licenciatura's perceived shortcomings. It is worth noting as well how the master is referred to as the fourth and fifth year of the expected level of student education.

6.3.3.2 Purpose

In Institution 1 two students intend to do a PhD, whereas two others consider either a PhD or a job in industry. This might be a reflection of the two possible orientations of the degree, theoretical and experimental. However, it is worth noting one student's opinion, with the caveat he makes, that a PhD can be a second-best option for students unable to get a job, and not necessarily the desired career path:

> ...at least here in Portugal it's not that easy, and a PhD with a scholarship is a very good opportunity to just do something. So they just try to keep themselves active and do a PhD. But that's just an opinion, honestly I don't know many people and it's just a stereotype I have. I may be wrong. As far as I know it's easier to get a scholarship for a PhD than to get a definite job, at least here in Portugal. (PI1.2)

In Institution 2 all students intend to continue their studies with a PhD, and believe that the master is geared to further studies or a research career:

> This kind of master in theoretical physics I think it's more to prepare us for a PhD and to do research. It's not really to work. (PI2.1)

6.3.3.3 Student competences

In both institutions students report a higher degree of independence, both during the thesis and during courses. Teachers expect students to work more on their own. Moreover, since the difficulty level of the courses is higher, they require more independent study:

> …the degree of difficulty in the first year in terms of the subjects you learn is more difficult. It requires more work and more independent study. About the second year, it's the beginning of research. You start doing research on your

> own, you have an adviser, but most of the work is supposed to be independent work. So that gives you a lot of skills and a lot of independence. (PI1.1)

Probably related to independence, all students also talk about initiative, motivation and a self-driven attitude:

> Those who come to the master, in principle, are already people who really want to be here and work much harder, with much more dedication. And that, possibly, is also reflected in the marks which generally are better in the master than in the bachelor. (PI2.4 - translated from Portuguese)

Most students in both institutions indentify specialisation in a precise physics area as a knowledge-related competence. Specialisation stands out for students in their experience of the degree:

> In licenciatura we get a more general formation and the master will give us a formation more specialised, more in the direction of some subject or some topic. (PI2.3)

It seems surprising that only about half the students refer to research skills as a competence they have developed during the degree, despite research emerging as the defining feature of the master (see next section) alongside independence and specialisation. One student describes a master student as ‘someone who can do proper research’, and another one deems research skills essential to the development of the master project:

> ...you should be more oriented to see papers and read the stuff and then think a little bit about it, than just read books and attend the classes (...) Because in the master degree you will have to do the project and you will have to do a lot of surveys, and papers and reviews. (PI1.3)

In Institution 2 some students also mention the acquisition of broad knowledge, critical thinking skills, creativity and communication.

6.3.3.4 Research dimension

Students in Institution 1 only discuss research in relation to the thesis and the opportunity it provides for their initiation to research. They have appreciative comments about the thesis experience, an aspect that stands out for them in the master:

> In the second year the thesis is a very exceptional experience, it's really good if you do a thesis on a subject that you like with good people, in the sense of scientists of good quality. To enter in a research environment, it's really, really nice. (PI1.1)

In Institution 2, students feel that the master offers them many opportunities besides the thesis to develop professionally as researchers, and that research blends organically with the training they receive. Their accounts suggest that many of the learning activities during the taught component of the course are typical activities a professional researcher would undertake, such as searching for literature, scientific papers and state-of-the-art research on specific topics, developing arguments based on the topics in question, making sense of them and presenting to fellow students and teachers:

> We had lots of presentations and we had to do research by ourselves, we had to read publications, search for publications, check the state-of-the-art and that kind of stuff, so we were able to develop those skills, at least in the last semester. We are continuing to do so during this part of the research during the thesis. (PI2.1)

> Since we learn much more independently, teachers give us a topic and we have to explore it, we have to develop it to present it afterwards to colleagues. And it is us who look for books, look for articles that have come out recently on the topic, or older; (...) we learn much more by ourselves because we have a topic and it is us who develop it at our own pace in order to understand it and to be able to, when it comes to presenting it, to expose what we learnt, to be able to do it in such a way that the teachers and the others that listen to us also understand what we did. (A4 - translated from Portuguese)

One student also mentions that teaching conveys recent knowledge and is sometimes informed by teachers' own research:

> In the master what we learned was more actual, more current, maybe in some disciplines we saw what our researchers were doing here in the university because they talk about some work they develop now and what they are doing. (PI2.3)

Thus, despite both programmes having a research orientation, this is experienced differently in the two institutions. The student experience generally mirrors teacher accounts about how research is integrated in the master. However, no matter how it is experienced, research comes to the fore as the defining experience of the master in comparison with students' previous educational experience.

In summary, students seem to perceive the master as a continuation of the licenciatura, the fourth and fifth year of the expected level of education. Their learning experience in the first year is hardly different from the licenciatura, however engagement with research stands out as the defining feature of the degree. In both institutions contact with research happens through the thesis; besides, in Institution 2 students are introduced to research practices already during courses. Despite appreciative comments on their research experience, it appears surprising that only about half the students explicitly mention research skills as a competence developed during the degree. The competences unanimously mentioned are independence and specialisation – these also emerge as hallmarks of their experience of the degree alongside research. All students in one institution aim to pursue a PhD, whereas in the other half consider further study and half a physics-related job in industry.

6.4 Denmark

The master degree in Denmark (*candidatus*) is regulated by national legislation. Official statistics and interviews at all levels of the implementation staircase indicate it is the default degree students pursue at university. The bachelor does not yet enjoy general acceptance as an exit degree. It appears that the legislative implementation of the Bologna three-cycle system has so far triggered only limited changes in the understanding of degrees, although some changes in practices have started to occur (i.e. inter-university mobility between bachelor and master).

The Danish academic master degree is known as *candidatus* and it is a higher education degree. It is the *candidatus* that forms the object of this research. Alongside, there exists a professional master offered in further adult education, known as *master*. The designations can be confusing, hence the importance of drawing attention to this aspect early on. Although I use 'master' for the sake of consistency across the thesis, in the case of Denmark this refers to the *candidatus* unless specified otherwise. The specificities of *candidatus* and *master* are addressed in section 6.4.1.3.

6.4.1 National/political conceptualisations

6.4.1.1 Structural aspects

Already in 1993 a university reform introduced a two-tier degree structure with bachelor and master. Before that all university study programmes consisted of one tier, lasted between four and six and a half years and led to the award of the master degree (candidatus). Subsequent legislation passed in 2003 and 2004 in the wake of the Bologna Process established the three-cycle structure. The *University Act,* passed in 2003 as a comprehensive piece of legislation, introduced changes to university governance, but also stipulated the study programmes universities could offer (Ministeriet for Videnskab Teknologi og Udvikling, 2003). The master degree (candidatus) appears as one of the three research-based degrees in university provision alongside the bachelor and the PhD. The act stipulates a credit value of 120 ECTS, with the mention that 60 ECTS correspond to one year full-time studies.

Ministerial order on bachelor and master's programmes (candidatus) at universities (no. 338 from 2004) stipulates in detail the conditions that must apply to the provision of master degrees (Ministeriet for Videnskab Teknologi og Udvikling, 2004b). It covers purpose, organisation, entry requirements, examinations, curriculum, master degree types and designations by discipline etc. These aspects will be addressed in the relevant sections. As to structural aspects, the order regulates again the attribution of 120 ECTS to the master degree. This is also reiterated in the Danish Qualifications Framework for Higher Education (Ministeriet for Videnskab Teknologi og Udvikling, 2008).

6.4.1.2 Relationship with bachelor

Despite a 3+2 organisation of studies existing since 1993, students would go to university with the assumption that they would study for five years and graduate with a master (candidatus), even though a bachelor degree was in theory awarded after three years. The bachelor degree was not formalised in any way, for example its completion marked by a piece of work. As a rule, students would automatically continue onto the master in the same university and the same programme after the third year. The 3+2 division was more pro-forma than real.

Further to the 2003 University Act, governance changes brought universities under pressure to implement study programmes according to the three-cycle system. Widespread scepticism arose about the bachelor's relevance and usefulness, as reflected in the comments of all national actors interviewed. There is unanimous agreement that there are issues with the employability of bachelor graduates, as the words of a Universities Denmark officer, speaking in a personal capacity, illustrate:

> The far majority of students who are awarded a bachelor degree will also do a master degree or a candidatus degree. So we haven't really discussed a lot the employability of the bachelor, because our labour market is also geared towards master students coming out of the universities. So for us maybe the whole discussion is a bit odd, and it's often hard, at least for the universities and for the student organisations as well, to see the advantages of expectations to have bachelor graduates beginning their careers after three years and not after five years. (Rikke Skovgaard)

Although so far the new degree framework has apparently not led to students actually stopping after the bachelor, several respondents' comments suggest it has had a positive effect on student mobility. It is becoming more common for students to change either discipline or university after the bachelor, as stated by the Danish Agency for International Education representative:

> Now I have the feeling that there are several master programmes that are able to both attract and enrol students with bachelor degrees that are not necessarily from their own institutes. Whereas that was, I guess, not so common a few years ago, that you would be able to take your bachelor from say the University of Aarhus and enrol in a master programme at Copenhagen Business School (...) I can definitely see changes compared to when I was a student and graduated myself in 2001. (Michael Huss)

Therefore the master emerges as *the* university degree in Denmark. The 2009 Bologna national report for Denmark refers to statistical data from 2005 according to which the great majority of graduates with a first-cycle degree (88%) continue their studies onto a second cycle programme (Danish Bologna Follow-Up Group, 2008, p. 10). The Danish Agency for International Education website[13] also states that most Danish students still continue onto a *candidatus* programme.

Interviews with national level actors reflect this reality. They find difficult to articulate the separation of the first two cycles and confess that their perception of university learning is still dominated by the idea of a five-year education. The master as a stand-alone two-year degree, or for that matter the bachelor as well, still do not seem to have clear identities in the five-year sequence of university education, as the National Union of Students representative indicates:

> I think that the idea that the bachelor degree is a finished programme hasn't been implemented yet. So the master programme is just like the continuing of the education you've started on your bachelor. So I think in order to implement the Bologna idea of the two cycles, you would have to acknowledge that the master programme is an education in itself, that it should have a beginning and an end (...) If you are discussing master programmes, then it's also necessary to look at how the bachelor degree is structured, because as I said in Denmark the two are not acknowledged currently and in many institutions it's still a 5-year education and not a 3+2 in practice, even though in the law it is. (Lena Scotte, DSF)

As a result, implementation of the bachelor-master structure might have been cosmetic only, and not accompanied by an in-depth revision of the degrees' content and purpose:

> The HEIs are very slow to change and in a lot of different education programmes it's traditionally been five years of education, so in the implementation of the two cycles they've just made a cut between the 3rd and the 4th year, but the content of the educational programmes has remained the same in a lot of cases. So the thought behind, for example, bachelor education and master programme has not been implemented yet in a lot of places. (Lena Scotte, DSF)

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13 http://en.iu.dk/education-in-denmark/detailed-information/higher-education (accessed 7 September 2011)

The distinction, however, appears problematic at all levels, not only for individual academics and HEIs. The words of the Ministry representative imply that authorities, too, are making a conscious effort to mark a clear separation between the two cycles:

> I think the Ministry is trying to make a clear distinction. But I think it's difficult to change, and maybe three or four years ago it was not so important. But also in our language it's being introduced more and more, and then we say ok, we have to change it in different places, the Uddannelsesguiden[14]... If you're looking right now I think they are introducing some changes, so it will be divided into bachelor and master programmes also there now. (Anne-Kathrine Mandrup, Ministry)

Another consequence of the struggle to see the degrees as two separate entities is the clash between strict entry regulations requiring completion of 180 ECTS to gain access to the second cycle and expectations of a flexible transition inherited from the old framework. As the student representative indicates, this mismatch explains the students' dissatisfaction with the difficulty of enrolling on a master when they only miss a small number of credits. As a result, regulations were softened in 2010 and HEIs now have discretion to give students special permission to start on a master and complete the missing credits at the beginning.

Evidence thus seems to suggest that enshrining the new degree framework in legislation has not yet triggered a shift in conceptions and practices and clear degree identities. The bachelor is a degree with little relevance and acceptance. Representatives of national authorities are aware that the two-year master is still perceived as a continuation of the bachelor, and that the standard university education is still equivalent to a master understood as a five-year education (candidatus). The difficulty in conceptualising the new degrees is thus experienced and acknowledged at the top policy level, too.

6.4.1.3 Purpose

The purpose of master programmes (candidatus) is defined by Ministerial Order 338 of 2004 as follows:

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[14] University Programmes Guide

‘1) enhance the academic knowledge and skills of the student and strengthen the theoretical and methodological qualifications and level of independence attained at bachelor level
2) provide the student with the opportunity to study in depth the advanced academic aspects of disciplines and methods in the subject area(s), including training in academic work and methods, which further develop the students ability to work in a specialist professional capacity and take part in academic development work, and
3) qualify the student for further studies, including PhD programmes.’ (Ministeriet for Videnskab Teknologi og Udvikling, 2004b)

It thus emphasises enhancement of academic knowledge and skills, both methodological and theoretical; a higher degree of independence; advanced disciplinary and methodological aspects; preparation of students both to ‘work in a specialist professional capacity’ and to ‘qualify the student for further studies’, thus illustrating a dual purpose of the master.

In addition, the order stipulates that the modular make-up of the degree ‘must ensure that the student is normally able to choose between skills profiles relevant to a variety of professions’, thus underlining the employability dimension of the master.

The academic master (*candidatus*) exists alongside the one-year professional master (*master*). This is a vocationally-oriented programme targeted at adults in a continuing education regime, typically part-time, enabling them to study while working.

The professional master is offered at second-cycle level, but it differs from the academic master with regards to length, funding regime, access to further study etc. The programme normally consists of two years part-time study, equivalent to a full-time year (60 ECTS credits). It does not grant access to a PhD. It is partially subsidised by the state and partially fee-based. A different ministerial order regulates conditions of provision, 1187 of 7 December 2009 (*Ministerial order on master programmes in universities*) (Ministeriet for Videnskab Teknologi og Udvikling, 2009).

6.4.1.4 Student competences

Student attainment at master level is set out in the Qualifications Framework for Danish Higher Education. Attainment is described in terms of knowledge and understanding, skills and competences, as follows:

‘Knowledge and understanding

- Must possess knowledge of one or more subject areas which, in selected fields, is based on the highest international research within a subject area.
- Must be able to understand and, on a scientific basis, reflect on the knowledge of the subject area(s) as well as be able to identify scientific issues.

Skills

- Must master the scientific methodologies and tools of the subject area(s) as well as master general skills related to work within the subject area(s).
- Must be able to evaluate and select among the scientific theories, methodologies, tools and general skills of the subject area(s), and set up, on a scientific basis, new analysis and solution models.
- Must be able to communicate research-based knowledge and discuss professional and scientific issues with both peers and non-specialists.

Competences

- Must be able to manage work situations and developments that are complex, unpredictable and require new solution models.
- Must be able to independently initiate and carry out discipline-specific and interdisciplinary collaboration and assume professional responsibility.
- Must be able to independently take responsibility for their own professional development and specialisation.’ (Ministeriet for Videnskab Teknologi og Udvikling, 2008)

Aspects that stand out are: advanced knowledge (‘based on the highest international research’) and critical understanding; mastery of methodologies and tools and ability to choose adequate ones for analysis and problem-solving; communication of research-based knowledge in plain and specialist language; ability to deal with complexity and uncertainty; initiative in undertaking collaborations; independence in designing learning and development. It is noteworthy that research comes through quite strongly both in the fields of knowledge and skills.

National level interviewees stress two competences, namely independence in learning and capacity to undertake research:

> I guess we are expecting people who have finished the master programme to be able to do research, or they should be prepared for PhD studies. And we don't have that expectation from a bachelor, that they should be able to do individual research. (Anne-Kathrine Mandrup, Ministry)

...and linked to research, critical thinking:

> the outcome of that, when you go through research-based education, I would say critical thinking, that you develop a skill or competence within critical thinking. (Rikke Skovgaard, DU)

Specialisation and ability to use knowledge in unfamiliar contexts to tackle new problems are also mentioned in one instance.

Some national level interviewees do not articulate the competences distinguishing master students from other qualification levels. They refer instead to the learning outcomes and competencies described in the qualifications framework and programme specifications. This is, however, natural given their lack of everyday interaction with teachers and students:

> To me a successful master student is the one who will rightly have achieved these competences and qualifications that are mentioned in the study programme (…) But as I do not know exactly what is written in this study programme for physics or any other study programme, then I cannot talk more than at a general level. (Michael Huss, Agency for International Education)

The fact that besides independence, research skills are the student competence most frequently invoked is telling of the perceived importance of research in the master degree for national actors in the Danish HE landscape.

6.4.1.5 Research dimension

Danish universities build on a strong Humboldtian tradition implying that education and research lie at the core of university programmes. The 2003 University Act thus stipulates the provision of 'research-based education at the highest international level' in universities and the 2004 *Ministerial order on bachelor and master programmes at universities* describes these as research-based programmes.

The research component is particularly evident in master programmes. The prominence of research skills highlighted earlier is a telling indicator. The ministerial order stipulates the weight of the thesis as amounting to minimum 30 ECTS points, or up to 60 ECTS if it is of an experimental nature. Moreover, the Ministry representative highlights that legislation regulates the thesis, the main research element of the master, in contrast with other curriculum aspects which are left to universities to decide. She thus underlines the significance given to research embodied in the master thesis (*speciale*):

> …the project is very important that you should show that you are able to do research, not only the methods, but actually showing that you've made some effort in your *speciale*, your thesis. So of course, I think that is very central for the master programme (…) As I said earlier, we have deregulated a lot, but what we have not deregulated is the thesis or the project. It has to be at least half a year and for many science subjects one year. Before we had a lot of orders for many different programmes, what kind of subjects they had to do and also what kind of exams. But now we've already said the universities can figure that out for themselves, they are those who know the subjects and they should be able to figure that out, if we have a kind of quality assurance to check on the output. But the thesis, if you look at the structure, what is regulated, it is mainly saying it's for a year (…) So that, I think, signals the very high importance, also from the Ministry, on this. (Anne-Kathrine Mandrup, Ministry)

According to the National Union of Students representative, it is the emphasis on research that separates the one-year vocationally-oriented professional master from the two-year academic master. She mentions a debate held in Denmark around reducing the length of the master. The two-year degree is presented as research-intensive, preparing students for a research career. Thus the argument for shortening the degree was that in the context of an expanding HE sector and more people going to university the labour market did not need that many people with research skills:

> I think it really depends on how research-based you want to be in your master programme. Because there have been discussions in Denmark whether we

> should have a one-year master, but it's only been lately in the last one or two years (…) The two-year master is preparing you to be a researcher and we don't really need that many - that was the argument for the shorter master degree – we don't need that many scientists. We need also people who have a higher education and can go and work for example in the private sector afterwards. And they don't need the two-year master. (Lena Scotte, DSF)

The importance attached to research emerges therefore as the justification for two-year master programmes.

From a national perspective, the master (candidatus) is still perceived as the default degree, the recognised university education traditionally taking five years. Passing legislation to legitimise the cycles has not triggered automatic acceptance of the bachelor, and the majority of students continue onto the master which enjoys esteem on the job market. National interviewees themselves confess to the difficulty of articulating the differentiation of the two cycles. These do not appear to have clear identities yet. The master's dual purpose – to prepare students for the labour market and for further studies – and its employability dimension are highlighted in legislation. However, the student representative believes that the academic master (candidatus) is more geared to prepare students for a research career, as opposed to the shorter professional master which is a means of professional development and up-skilling. The research orientation of the degree transpires from legislation (the Ministry opted for the regulation of the thesis while leaving responsibility for other curricular aspects to universities), from the student competences in the qualifications framework which mention research in several instances and from the interviews which identify research skills as one key competence for master students. Besides research, independence, advanced knowledge and the ability to deal with complexity and uncertainty emerge as master student competences.

6.4.2 Academic conceptualisation

No discrepancies have been noted in the opinions of teachers from the two institutions. They express similar views on the degree framework and the master's position in it, on the degree's purpose and student competences. The incorporation of research in the degree is also reported to occur in similar ways.

6.4.2.1 Structural aspects

Since the new provisions regulating the degree framework have not affected the overall conditions leading to the awarding of the master, academics' understandings of the degree do not appear to have been challenged by legislation enforcing the organisation of studies along the Bologna model. However, mobility effects might have the potential to shift conceptions in the longer run.

Academics still think of the master mainly as a five-year education, rather than a discrete two-year upper cycle building upon the three-year bachelor. The master is not perceived as structurally separate from the bachelor, whose implementation has had little effect on conceptions of the master itself. The current master is still the degree academics had in mind previously. It appears that until the bachelor develops an identity of its own, the master as a two-year degree will not have distinctiveness. The following statement illustrates the merging of the bachelor and the master in one long education:

> When I'm talking about the master, I'm talking about a five-year education. Of course we have a few students that migrate between universities after the bachelor. I think it's very limited though. But in principle you can come to a master programme after three years in another university (…) It's not highly separated. For a student who takes both the bachelor and the master in [institution], it's a sort of smooth transition. And most people, they just start taking some of the courses for their master before they finish their bachelor. That's quite common. (DI2.4)

As a consequence, the master proposed by the Bologna three-cycle scheme only appears to exist formally. However, mobility has the potential to change perceptions. One lecturer's statement is telling in this respect, the master gaining distinctiveness with the admission of students from other universities, but not for students who have stayed in the same university:

> We are aware that we could have some bachelor students who are coming from other places and we should be able to give them a complete master programme without having to think about it as a five-year degree programme. But at the same time it's certainly true that when we talk about our own students, we still think of it to some extent as a five-year programme. And it

> can be an advantage because it means they've started on something, they've made some specialisation that they haven't finished before and they can continue that at the master level. (DI2.1)

6.4.2.2 Relationship with the bachelor

As noted in the section on the reception of the Bologna Process, academics view the bachelor's implementation with scepticism. Despite a 3+2 structure already in place, university education has been traditionally understood as five years (master level), hence a tacit assumption, and expectations, in Danish academia and the Danish society that university students will complete a five-year education. In this context, bachelor degrees make little sense, as expressed by a lecturer:

> We have no tradition for bachelors here. In fact students only take a bachelor here if they have some kind of problem or are doing very, very badly in the courses. So most students pursue a master degree or a PhD degree. You cannot really graduate with a bachelor here and then go out and get a job because all other people that you are competing with will have a master degree. If you want to have a three-year education in Denmark, you typically go to what we call professional schools where we have specially designed education for particular purposes. (DI2.3)

The bachelor is thus perceived as an insufficient and lacking degree. Its legislative enforcement felt like an external imposition and implementation appears to have been done half-heartedly, out of obligation, by artificial inserting it in a longer education, as the statements below demonstrate:

> ...essentially we've been squeezing in this bachelor degree after three years. And it was not very well received. Why do we need to have a bachelor? (DI2.2)

> ...we had to divide our courses into bachelor and master, and this was a mess for a long time. And until recently it wasn't really clear where the division line was, so it has taken like five years. (DI1.1)

The bachelor and the master degrees do not, therefore, appear to have their own distinctiveness yet. The boundary between them as separate cycles is blurred. The bachelor appears as a sub-component of the master, an unfinished education, rather than an autonomous degree in itself – hence the expectation that students will stay at university for five years. This view, in turn, gives the master the status of the appropriate degree. However, mobility is perceived as a positive outcome of the implementation of the bachelor further to Bologna:

> I think that a bachelor in physics is not really enough, I must say. But especially for Bologna, the way I understand it, I would like to see that the students complete the bachelor studies at one university and then they sort of look around and find another suitable university in Europe to get their master. (DI1.3)

One academic believes that acceptance of the bachelor in universities is a pre-condition of the degree's acceptance in the society at large. Academics' lack of conviction, universities not 'taking it seriously as a degree in itself' and not promoting it, are probably also to blame for the bachelor's lack of recognition in the society. In addition, changes need time to gain acceptance, and it has only been a short time since the bachelor was implemented in practice. However, the responsibility for promoting the benefits of the bachelor lies not only with universities. A sense of frustration emerges that its introduction was not accompanied by measures to raise awareness:

> The people who take our candidates, whether it's at the bachelor level or the master level, they also have to be used to the fact that there are bachelors around. Ten years has been a rather short time for the people we supply students to, to get used to it. And a lot of the places have not really started thinking that perhaps they could do with a bachelor rather than a master. So we are definitely to blame here, the university, but it's not only us. There has not been a thorough marketing of the bachelor degree in Denmark as such. (DI2.2)

Summarising the above discussion, the master corresponds to the expected education level of a Danish graduate. It has maintained its status as the default degree: the degree in which employers have confidence; the degree that students have in mind when going to university; the level to which teachers aim to bring students:

> To be honest, I think of it as THE degree. I think it still is the typical degree, THE degree that people will get from university. I know people who leave with a bachelor degree, but it's not a lot, so I still think the master feels as the correct degree to give a student coming out. So actually we are trying to implement the Bologna system without really implementing it. We have the bachelor, it's supposed to be there, but we're not trying to push a lot of people through and get them out as bachelors. We're trying to carry them through and make them master students as much as we can. (DI2.2)

Therefore, the master is understood as a five-year education, rather than a two-year independent degree following a three-year bachelor. Consequently, the bachelor does not have individuality by itself and is not yet fully accepted as a valid degree. However, increased mobility between universities between cycles begins to change perceptions – students coming from other universities force a re-conceptualisation of the master as an independent cycle, so that it can become meaningful and self-contained for them, too.

6.4.2.3 Purpose

In both institutions, a consensus emerges that the master is preparation for both further studies (PhD) and for work in areas like industry, engineering, the financial sector, hospital sector, high-school teaching etc. Students have freedom to choose courses suited to their interests, taking them towards the career they wish to follow:

> It's supposed to be for both. I mean, it's not directed towards any specific professions. The idea is really that you can go out in industry, or you can take a job as a teacher in a secondary school, or you can go into a hospital or what not. So it's sort of a generalist education. But since they have this freedom in how they compose their programme, they can make a programme which is directed more towards one kind of thing than towards another kind of thing, one which would maybe be more suited if they were going into private industry or another which would be more suited if they were heading for the hospital. (DI2.1)

In Institution 1 the proportion of students pursuing PhDs versus employment is reported to be roughly half and half.

In Institution 2 one lecturer indicates that they try to attract the best students onto the PhD programme. However, there is an alternative PhD route which does not follow the 3+2+3 structure. For students who want to do a PhD the popular route is 3+1+4. Students get accepted onto the PhD after one year in the master, thus having more time to specialise in a specific research area. Halfway through the PhD students have a qualifying exam and are formally awarded a master degree.

Given the perception of the master as the default degree (and the qualification recognised on the job market), its double orientation does not appear surprising.

6.4.2.4 Student competences

Independence emerges as the one competence lecturers in both institutions unanimously expect of master students. It refers to autonomous, self-driven learning, for instance in driving forward research projects:

> I think they are much more mature in learning things by themselves. From an undergraduate you cannot expect to give them a subject and, you know, 'go read this and come tomorrow and explain it to me'. Really there is a big difference between a student in the third year and in the fifth year (...) I think that's the main difference, how individually they work (DI1.1)

Independence is also understood as the students' ability to identify their niche of interest, to decide what area they want to pursue in their career and to take initiative in designing their learning programme accordingly:

> ...finding out what it is that interests and excites them (...) Maybe I'm saying it too strongly, but define something that you think 'I have to do this for my life to be complete at all levels'. And so I think that certainly being able to have the discipline to go through a year-long research project is one thing, but also just being able to figure out what one wants to invest that time and energy in; and preparing for it by taking appropriate courses, and talking to people and putting together a project like that. (DI1.2)

Advanced knowledge is also mentioned almost across the board:

> ...technically they would be at a higher level and they should be able to apply the physics in different situations and at higher level than in the bachelor degree (DI2.1)

Motivation and engagement appear in about half the accounts in each institution. Expectations of motivation are linked to the fact that students work in an area of their own choice rather than following a prescribed curriculum:

> I would expect also that the student has a higher engagement in the teaching, that they show more personal interest in their studies, partly because they get this higher freedom. It should be something that they're doing because they have an interest in the courses, in the subject, not just an interest in getting the degree and getting out. (DI2.2)

Problem-solving skills are mentioned almost unanimously in both institutions, namely students' ability to draw on broad knowledge to tackle problems:

> ...they should be able to bring into play the different things that they have learnt in their undergraduate studies, I think that's very important for physics. And if you have a problem then you should look at it from different angles and be able to go back and precisely pick out the piece of knowledge, and you may have forgotten in detail what you learnt, but somehow you should have an overview and be able to go back and pick the right arguments. (DI1.3)

Despite the evident presence of research in the master curriculum (see below), it is rather surprising that teachers in both institutions hardly refer to research skills explicitly when asked about the competences expected from master students. However, a preoccupation with research does permeate their accounts.

In addition, the following competences are mentioned in isolated instances in one or the other institution: critical thinking, abstract thinking, written and oral communication skills.

6.4.2.5 Research dimension

In both institutions the degree's research dimension gains expression in similar ways. The thesis is the main opportunity of immersion into research. Students are associated to a research group and undertake a project independently. Engagement with research during the thesis is similar to an apprenticeship and a process of socialisation into the physics profession:

> ...to come back a little bit to this thesis work, that's where the students start to feel like fully-fledged physicists, and I think it's important that they end up being able to act a little bit like researchers, posing problems and being able to attack them. (DI1.2)

It is also worth noting one teacher's remark that the Danish master is a research qualifying degree:

> The master degree according to the Danish tradition is really a research qualifying degree. It's not a PhD, but it's still a degree where you have independent research work. It is supervised research work, it's not like you have to go and make up your own scientific problems, but the students tend to work very independently on whatever problems they are assigned. (DI2.4)

Another manifestation of research in the master in both institutions is research-based teaching, either by lecturers including research literature in reading lists and drawing on their own research activities, or by involving research groups in teaching to ensure students are introduced to latest knowledge:

> For our master programme the emphasis has been to have a good structure of courses related to our most active research areas and we have a structure where we have research groups (...) And then it's important together with these groups to discuss to see how to have a good course programme that covers these areas (...) For example I think ten years ago we had very few courses in quantum optics, but now we have a very strong group in quantum optics and that should reflect itself in the course programme. (DI1.3)

In addition, students are familiarised with research practices such as literature reviews, critical reading of literature, reports on research articles, presentation of research findings, etc:

> I have taught several times seminar courses where the point is to learn how to deal with research literature, so that students then take turns from meeting

> to meeting and each student will be assigned an article and that student is responsible for reading it in detail and presenting the results to the rest of the class. They also review articles and are supposed to come with reasonable questions about what happened. (DI1.2)

In one institution one lecturer mentions that sometimes staff have their own research projects and involve master students in them.

To sum up, Danish academics interviewed in this research view the master degree as the adequate level of education for Danish graduates. The bachelor does not yet enjoy acceptance and does not have its own identity. It appears as a sub-segment of the five-year long education which concludes with the awarding of the master. The master still appears to be understood as a five-year education rather than a discrete two-year cycle following the bachelor. However, mobility effects already seem to shift perceptions. The master is portrayed as preparing students equally for further studies and for entering the job market. In both institutions research appears to infuse the master through research-informed teaching, induction of students to research practices and the development of the thesis (*speciale*). However, research skills are hardly mentioned explicitly as master student competences. In this respect, academics place emphasis on independence (in learning and in designing a learning trajectory suited to one's interests), advanced knowledge, problem-solving skills and student motivation.

6.4.3 Student conceptualisation

Against the emerging consensus among teachers in the two universities around the analysed dimensions of the master, it has been surprising to note differences in the students' experience and perceptions of the degree between the two institutions. These are mainly related to research.

6.4.3.1 Structural aspects and relationship with the bachelor

Issues related to the degree framework and the master's relationship with the bachelor hardly came up in interviews, probably because the formal implementation of the bachelor has not had any impact on students' learning experience. Moreover, their experience is limited to their study period, so they lack prior references for comparison. One student only makes a remark, namely that master courses are similar to the undergraduate ones, but at a higher level.

6.4.3.2 Purpose

In Institution 1 all students intend to continue onto a PhD (one has just started), however one of them would consider a job should a PhD prove difficult to obtain. He talks about the range of possibilities open to physics students:

> I think it's very probable that I would pursue a PhD, but if not I could try to find some job, but it's difficult to know what kind of job, also because in my kind of study there are a lot of possibilities afterwards. (DI1.1)

In Institution 2, however, only one student wishes to do a PhD, and the remainder (3 out of 4) envisage a job outside academia (although one of these considers an industrial PhD and then work in a company).

The difference can appear remarkable. However, the student sample is not a representative one, so these intended destinations might be a coincidence. Besides, in Institution 2 the alternative route for a PhD (3+1+4) might suggest that students already in the second year of the master would normally aim for a job outside academia. As shown earlier, teachers in both institutions reported that the master was meant as preparation both for further studies and for employment outside academia.

6.4.3.3 Student competences

An independent style of learning, capacity to understand what one needs to study and to manage one's learning, and initiative to drive forward one's studies is mentioned by students in both institutions. Besides, independence is identified as a hallmark of master education:

> To think more independently, you know, the teachers do not look so much over your shoulder, you are a little bit more on your own in your master thesis. At least the thesis is more like enabling you to manage your own time and work individually compared to doing courses (...) And also you need to take more responsibility for your own learning on the master. (DI2.1)

> There's bigger need for personal dedication, there's less holding hand from the teachers. So in that sense you need to be better at studying yourself than when you're in the undergraduate studies. (DI1.2)

Motivation also appears in most student accounts in the two institutions:

> ... the master student has actively selected a topic in which to study. So I guess even at undergraduate level you pick some courses you find interesting. But that interest has to be something that you actually want to spend two years on, on the master's. (DI1.3)

Since research is a salient feature in Institution 1 (see next section), it is not surprising that most students mention research skills and research flair when asked what characterises a master student:

> ... to research, to think about what is interesting, what is new, if you see something new then go discover it (…) Writing articles is real stuff, showing that you do research, when you are part of a group writing articles, then you get the sense that now you're doing research. (DI1.4)

Interpersonal and communication skills are also mentioned in Institution 1 among the competences some students feel they have developed during the master. This appears related to their integration into a research community and conducting research within a group:

> I've become better at recruiting knowledge and help when I've worked in a group, I've become better at talking to the different people that are there, not only my own counsellor and the professor that I know, but also the other post-docs, PhD students, other master students and sort of learnt how to get ideas and input from other people. (DI1.1)

In contrast, in Institution 2 some students highlight specialised knowledge and knowledge application to new situations and problems:

> A master student has had all the basic stuff and then gets an understanding in the broad sense of the matter, what they are learning, and then applying

> the basic stuff to more advanced problems. We are using the knowledge we have on a higher level than an undergraduate. (DI2.3)

Advanced and broad knowledge and problem-solving are only mentioned in one instance each in Institution 1.

6.4.3.4 Research dimension

Student accounts reveal a significant difference between the two institutions: the prominence of research in their learning experience. The extent to which they dwell on research is telling.

In Institution 2 they hardly bring research into discussion: one student describes coming into contact with research through the thesis, whereas another one speaks about research-informed teaching. Research does not emerge as a defining feature of the master, as is the case with Institution 1 students.

In contrast, in Institution 1 engagement with research is mentioned by most students as the outstanding experience of being a master student. They dwell quite a lot on describing how the degree gives them opportunities to grow as researchers: research-informed courses, extra-curricular activities, the thesis and the benefits of a research community.

Students agree that a research component permeates master courses through exposure to other people's and to teachers' own research:

> also in the courses I think it's more research-oriented, because the courses are at such a level that often the teachers will be able to say 'actually what I'm telling you about right now is what I'm researching on'. (DI1.3)

Beside courses, it appears that students are presented with extra-curricular opportunities to develop research abilities, i.e. activities such as conference attendance or research seminars:

> ...my research group and my counsellor, they've taken me on sort of small conferences, but informal, we would go somewhere two or three days and maybe just give small talks to each other. And I've also been with my own

> group three days away where we just talked about what we were doing, so you get an idea about what other people in the group are exactly doing, what their research interests are (…) Once a week there's a seminar for the research group. It's open for everyone. It's something I typically attend every second time, maybe. (DI1.1)

...or internships abroad, working on research projects:

> in [country] I had an actual scientific research-oriented project, with everything that comes when you have to do a scientific research project. This is the first time I've been involved in a project like this, which is a significant difference from taking a course. (DI1.3)

Students also identify the thesis as an activity which allows extensive immersion into a research topic, brings satisfaction and allows engagement with 'real' or 'original', or 'real, new' research:

> The big difference is that you are able to do individual research as a master student...It's actually the master thesis in a group and doing real research, new research. (DI1.4)

Two students also mention publishing findings of research conducted during the master:

> I think definitely writing the thesis I'm actually doing real research and I'm going to publish something that I've been working on. (DI1.1)

Most students also talk about their integration into a research environment while undertaking their master project – this is experienced as an induction to the physics profession, an initiation to the discipline, learning by seeing, leading to students' development as physicists and researchers:

> The most important thing being a master student as opposed to an undergraduate student is that I am learning what a research community is about. I'm slowly picking up what research is, how research works, how research is conducted. (DI1.3)

Thus, the extent to which students talk about research varies greatly in the two institutions. Nevertheless it is difficult to establish a clear cause-and-effect connection. It might mean that research does not stand out in Institution 2 because it was a dimension of undergraduate teaching as well; it might be that students simply did not bring it up by themselves as was the case in Institution 1, and I failed to elicit further information from them; or it might be that research is not as pronounced a feature of the master as the teachers' accounts would suggest, or that students fail to recognise it as such.

Summing up, the accounts of Danish students interviewed suggest different experiences in the two institutions with respect to the research dimension of the master. This is reflected in the emphasis they place on research as part of their learning experience and the extent to which it appears to be an outstanding element of the degree: pronounced in Institution 1 and low in Institution 2. This difference is also reflected in the competences students feel they have developed as master students: in Institution 1 research skills stand out, whereas in Institution 2 it is more specialised knowledge and knowledge application that are highlighted. In both institutions, however, students underline independence in learning and motivation. The intended destinations – PhD in Institution 1 and mostly jobs outside academia in Institution 2 – might also be telling of the perceived weight of research in the student experience.

Chapter 7 Teaching and Learning

So far I have analysed the reception of the Bologna Process in the three countries and the different actors' interpretations of it, as well as their conceptions of the master degree. In each country these context-determined conceptualisations influence teaching and learning practices employed in the delivery of the master. This chapter focuses on understandings of the learning and teaching process, as well as pedagogic practices in physics MSc degrees. It thus includes a pronounced disciplinary dimension, since disciplinary factors, too, influence learning and teaching practices apart from context-related factors. The choice of discipline, the nature of physics and how it finds expression in teaching and learning were explained in Chapter 4.

The analysis addresses a number of dimensions which combined provide an overview of pedagogic practices, as well as practices meant to support and inform the teaching and learning process: course composition, learning outcomes, ECTS, teaching methods, student learning and assessment practices. As with previous chapters, I approach each country and the sub-levels of analysis (implementation staircase actors) in turn. European and national actors' views of learning and teaching are of a rather general nature given their lack of day-to-day exposure to institutional practices. As such, they cannot comment on more specific programme information such as course composition. Learning, teaching and assessment are also discussed more generally under the umbrella of pedagogy. Thus, some analysis dimensions are sometimes merged together at the European and national levels.

Given its focus on learning and teaching, this chapter builds primarily on the experiences and practices of the academics and students interviewed for this research, representing the two sets of key actors involved in the educational exchange.

7.1 European perspective

First, it is pertinent to address briefly Bologna's growing attention to the shift in pedagogic paradigm in recent years, as well as the understanding of the concept of student-centred learning. Whereas the earlier *Trends III* report (Reichert & Tauch, 2003) refers only once to student-centred learning, the latest report from 2010 discusses the concept extensively and describes the shift to student-centred learning as the ultimate measure of the success of the Bologna reforms (Sursock & Smidt, 2010, p. 32). Student-centred learning has gradually moved into the foreground and emerges as the concept with the potential to give cohesion to the Bologna tools and action lines.

Trends 2010 lists several characteristics of student-centred learning observed in European HEIs which, according to the report, have been driven by the Bologna Process:

- a shift in focus from the teacher and what is taught to the learner and what is learnt
- a different teacher-learner relationship whereby the teacher becomes a facilitator and the responsibility for learning is shared
- learners approached as individuals with specific experiences, backgrounds, learning styles and needs
- learners constructing their own meaning through proactive learning and reflection and teachers building critical thinking in the learning process
- involvement of learners in deciding what is learnt
- a focus on outcomes rather than inputs
- a focus on critical thinking and deeper understanding rather than knowledge transfer
- formative assessment and continuous feedback. (Sursock & Smidt, 2010, pp. 31-32)

One aspect to bear in mind in the analysis of pedagogic practices is the extent to which these have appear to have been influenced by the student-centred learning concept further to the Bologna Process.

With regards to physics, I rely mainly on two recent European Physical Society (EPS) publications to provide a European level perspective on learning and teaching in physics master degrees: *The Implementation of the Bologna process into Physics in Europe: The Master Level* (Kehm & Alesi, 2010) and *A European Specification For Physics Master Studies* (Ferdinande, 2009). I also draw to some extent on the recommendations of the *Tuning* project for Physics, *Reference Points for the Design and Delivery of Degree Programmes in Physics* (Tuning Project, 2008).

7.1.1 Course composition

Kehm and Alesi's study (2010) comprising 129 universities from 24 countries shows that the majority of the surveyed physics master programmes last for two years in continental Europe and the Nordic countries. It also highlights that in the UK almost half are integrated masters of four years (38%) or five years (8%), the latter being in Scotland. The rest are stand-alone programmes of one (47%) and two years (7%) (Kehm & Alesi, 2010, p. 16).

According to Kehm and Alesi, in two-year master programmes the first year or the first one and a half years are devoted to deepen specialisations, often coupled with generic physics courses. The last six months of the second year are typically devoted to the thesis, usually assigned 30 ECTS (Kehm & Alesi, 2010, p. 26).

As to programme composition, the EPS master degree specification recommends some curricular considerations it deems essential. First, it lists a number of possible physics sub-fields of which students should 'gain a thorough understanding' or in which they should learn to apply knowledge and skills, and states that curricula 'should help master students to achieve a more qualitative understanding of current developments at the frontiers of the physics discipline'. It emphasises the relevance of advanced mathematical and computational methods in physics as modelling and problem-solving tools. It also highlights the practical nature of physics and the importance of practical work in laboratories, internships, research centres etc. It underlines the importance of project work to facilitate the development of student skills in research and planning (Ferdinande, 2009, pp. 8-9). Thus, in brief curricula should address deepening students' knowledge, knowledge application, awareness of disciplinary state-of-the-art, mathematical methods, practical components and research training.

7.1.2 Learning outcomes

Alongside the growing importance of student-centred learning in the first Bologna decade, learning outcomes have emerged as the tool embodying the new pedagogic approach. The 2005 Bergen Communiqué mentions for the first time the impact of structural changes on the curriculum and the need for 'innovative learning and teaching processes' (Bergen Communiqué, 2005, p. 1). Two years later, the London Communiqué mentions for the first time learning outcomes. It highlights the 'move towards student-centred higher education and away from teacher-driven provision' as a significant outcome of the Bologna Process and calls for the implementation of ECTS based on learning outcomes and student workload (London Communiqué, 2007, p. 2). *Trends V,* too, states that Bologna's 'most significant legacy' will be a change of educational paradigm in Europe; however, this shift is still in early stages, and understanding and integrating the use of a learning outcomes approach remains a medium-term challenge (Crosier, Purser, & Smidt, 2007, p. 8).The 2009 Leuven Communiqué, indeed, identifies student-centred learning as a priority for the decade to come, reasserting 'the necessity for ongoing curricular reform geared towards the development of learning outcomes' (Leuven Communiqué, 2009, p. 3).

Student-centred pedagogy finding expression in learning outcomes has thus gradually moved from the periphery to a central position in the Bologna discourse. However, *Trends 2010* highlights that student-centred learning is a concept open to different interpretations (Sursock & Smidt, 2010, p. 31). This is reflected in the understanding and use of learning outcomes. For instance, with regards to practice in physics master programmes, Kehm and Alesi's survey concluded that in many countries the concept of learning outcomes and how to employ them still remains unclear, more time being needed for experimentation and change (Kehm & Alesi, 2010, p. 27).

7.1.3 ECTS

The survey on the implementation of European master programmes found that ECTS is a widely established practice (86% of respondents) and typically programmes require the completion of 120 ECTS (Kehm & Alesi, 2010, p. 14). In the majority of programmes (92%) credit calculation is based on contact hours plus individual study. Student work, when defined in curricula, consists of presence in class, self-study, and laboratory and project work. The study does not give any information on whether ECTS points are anchored in learning outcomes, according to Bologna recommendations.

69% of respondents report a workload of 25-30 hours to one ECTS point, which follows the Bologna guidelines. Universities in the UK and Ireland are highlighted as the exception, with 67% using the CATS system and indicating 10 hours of work for one credit (in everyday practice two CAT points correspond to 1 ECTS) (Kehm & Alesi, 2010, pp. 17-18).

7.1.4 Teaching and learning

There is little information in the literature on common patterns in teaching and learning in physics degrees across Europe. The Tuning publication *Reference Points for the Design and Delivery of Degree Programmes in Physics* lists a wide range of educational activities encountered in physics (Tuning Project, 2008, p. 59). However, it then recommends pedagogic methods best suited to develop physics-related student competences identified by the Tuning exercise. It thus draws on so-called best practice to make recommendations on student-centred and output-focused pedagogy rather than present an actual picture of learning and teaching methods.

The recent EPS publication *A European Specification for Physics Master Studies* lists typical teaching methods: lectures supported by problem classes and group tutorial work; laboratory work; use of textbooks and other self-study materials; open-ended project work, which may be team-based; activities devoted to physics-specific and generic competence development. However, in listing them it draws upon the physics benchmark statement produced by the QAA in the UK (Ferdinande, 2009, p. 6).

As to generic competences, the study by Kehm and Alesi reveals those transferable skills that respondents considered to be part of their programme curricula. The highest choices were communication skills (77%), social skills (62%), international competences (62%) and self-organisation competences (59%). Usually transferable skills development is integrated into physics curricula (61%), however provision is sometimes offered in separate courses. The majority of respondents in universities (as opposed to technical universities) noted a rise in the acquisition of transferable skills and 23% associated it to Bologna (Kehm & Alesi, 2010, p. 29).

7.1.5 Assessment

The EPS specification for master programmes lists a range of assessment methods in physics, again inspired in the QAA physics benchmark (Ferdinande, 2009, p. 6). Kehm and Alesi’s survey also reveals the existence of a variety of assessment methods, the most common being: written tests (93%), oral examinations (79%), project presentations (77%) and homework papers (67%). Students are usually assessed on completion of the module or unit of teaching. Student performance during the course is increasingly taken into account in the final grade, thus reducing the weight of final assessment. 44% state that they only test subject knowledge, whereas 56% examine both subject knowledge and transferable skills (Kehm & Alesi, 2010, p. 25).

Summing up, the main learning and teaching aspects in physics MSc degrees across Europe reported over the past years are the following:

- predominance of two-year programmes (the thesis usually lasting for six months), UK being highlighted as the exception by the two most recent EPS reference publications
- curriculum design addressing in-depth student knowledge, knowledge application, disciplinary state-of-the-art, mathematical methods, practical training and research training
- lack of clarity around the concept and use of learning outcomes
- widespread use of ECTS, and calculation based on contact hours and individual study in most cases; typically master programmes comprise 120 ECTS
- variety of teaching and learning methods
- acquisition of transferable skills integrated into physics curricula rather than in separate provision
- diminishing weight of summative assessment.

7.2 England

Especially national level actors, but also some interviewed academics in England, talk about established pedagogic traditions valuing student-centred education. Bologna, perceived as a structural reform, appears to have had little impact on learning and teaching practices and, as mentioned earlier, it was received as a policy initiative of little concern for lay academics, believed to need attention at higher decision-making levels in HEIs. Probably the only Bologna-triggered change noted in this study was the adoption of ECTS in one HEI. The other pedagogic tool which Bologna started to promote later on, learning outcomes, was already embedded in institutional practices in England.

7.2.1 National/political perspective

7.2.1.1 Course composition

Master's degrees characteristics states that providers will define the curricular content depending on the degree's intended purposes, since master degrees often fall outside traditional disciplinary boundaries (QAA, 2010, p. 4). About the MSc, classified as a specialised/advanced study master's, it states that it is predominantly composed of structured learning (taught), with frequently at least a third of the programme being devoted to a research project. The most common duration is twelve months full-time (QAA, 2010, p. 12).

7.2.1.2 Learning outcomes

Arguments defending the one-year master and claiming parity of position with programmes of longer duration invoke learning outcomes. There is a perception among national representatives that the UK has travelled far in the understanding and embedding of learning outcomes, while the rest of Europe is only now moving towards their adoption, with variation in interpretations in different countries. However, in England the focus is clear and anchored in experience. The concern is with output rather than input, as the following statement by the QAA representative demonstrates:

> It is learning outcomes that is our currency. So not how long a student studies, either per week or over the course of the whole degree, what the qualification of that student was on entry, what his or her career aspirations are. We take our currency as outcomes; that's how we measure standards. (Laura Bellingham, QAA)

However, using learning outcomes as a justificatory argument to legitimise the one-year master is criticised as a defensive rather than a constructive stance. The Institute of Physics representative also remarks that British arguments based on learning outcomes to defend the degree structure appear backward- rather than forward-looking – what he calls 'retrospective justification' rather than 'planning'. The NUS representative appears to agree:

> …the UK, I suppose, has been trying to explain or justify, probably it's not quite the right word, but has tried to make people aware of why a one-year master is a recognised qualification, and that it is possible to get the same outcomes after one year as after two years (...) But I think it's been more from a defensive position of how can we justify it, rather than what can we actually change to make it better. (Alex Bols, NUS)

Nonetheless, there is some acknowledgement of the difficulty to elude the time factor in the attainment of outcomes. Founded and solid as the approach might appear, disbelief about the irrelevance of study time for the outcomes of student learning is understandable from a common-sense perspective, as stated by the Department of Business, Innovation and Skills representative:

> …certainly from a UK perspective we would say the learning outcome is more important than the hours served or the time spent. And the two aren't incompatible. But speaking intuitively if someone is learning something in Germany and it takes two years, can it be theoretically possible to learn exactly the same in a year in the UK? I can understand people who question whether or not that's achievable. (Peter Baldwinson, BIS)

7.2.1.3 ECTS

As highlighted in Section 5.2.1, ECTS was one concern identified during the Education and Skills Committee's inquiry into the Bologna Process (House of Commons Education and Skills Committee, 2007a), since its understanding in Europe as a time measure could pose challenges to the recognition of English degrees. The guidance document for the English credit framework explicitly links credit to learning outcomes, stating that 'credit is awarded to a learner in recognition of the verified achievement of designated learning outcomes at a specified level' (Credit Issues Development Group, 2008, p. 2).However, the fact that until 2008 England did not have a national credit framework hindered its capacity to argue for a credit system anchored in learning outcomes.

Given the UK emphasis on output rather than input to characterise degrees, most national representatives express scepticism at the ECTS system and the value of workload. ECTS interpretation and usage are criticised as still very much based on contact hours because of the difficulty of measuring with accuracy individual study time. ECTS is thus described as unreliable; this is compounded by the fact that different countries use different means of implementing ECTS:

> I think we still have an issue – and this is where you get the anecdotal evidence – about whether or not ECTS is properly implemented and used in some member states' higher education systems. We have some voices of doubt bordering on scepticism as to whether people who say they've got 120 ECTS can actually demonstrate that the course they undertook actually delivered them. (Peter Baldwinson, BIS)

Consequently it feels more appropriate to them to anchor ECTS in learning outcomes instead of study hours. Several mention the revised 2009 *ECTS Users' Guide* which has somewhat redressed the balance in favour of learning outcomes. However, there is frustration at persisting references to workload casting an unfavourable light on Britain:

> I think definitely the guide is an improvement on the one before, and there's much more of an emphasis on recognising learning outcomes and how you appropriate credits to learning outcomes. But if you look at the back, as an annex they still have this very unhelpful table which shows student workload. And it describes student workload in Britain as 1200 hours per year and you then compare this to some countries which have 1600-1700. (Peter Dowling, Europe Unit)

The Institute of Physics representative sympathises though with the view that British students work less hard and that the English master is less demanding. In this respect, he discusses the employed correspondence between ECTS and the English credit system (1 to 2). However, one ECTS corresponds to 25-30 hours, whereas one English credit stands for 10 hours – thus two credits (equivalent to 1 ECTS) amount to 20 hours, rather than 25-30. Thus, not only the number of hours per credit is inferior, but also the credit range of the English master is usually lower, which for him is telling of the degree's misalignment.

Therefore ECTS is generally met with scepticism because of the perception that in Europe it is understood and implemented with reference to the time dimension, whereas in England learning outcomes are the currency for characterising degrees.

However, the importance of time for the achievement of learning outcomes is also acknowledged.

7.2.1.4 Teaching and learning

Master's degree characteristics states that teaching and learning should draw on a combination of delivery methods appropriate to the programme's aims. It underlines the link between learning outcomes and teaching design, stating that programmes will be 'supported by an integrated teaching, learning and assessment strategy that demonstrates the appropriateness of the learning, teaching and assessment methods used in relation to the intended learning outcomes'. The publication also indicates that master degrees place greater emphasis on methods involving independent study (QAA, 2010, pp. 7-8).

Respondents comment only generally on teaching and learning aspects in master degrees. Student-driven learning is described as predominant in England; however at master level pedagogic approaches should place even more emphasis on student-led and student-centred learning. It is this style of learning that according to one interviewee enables students to achieve master level learning outcomes in one year only, following their continued exposure to student-driven learning since the undergraduate degree:

> ... when you're looking at the Dublin descriptors on what it is to be a master's, it is possible to get those characteristics after a one-year master's, particularly if you've done a three-year English degree beforehand, which are quite different in terms of the way they approach the education to many of the other European countries, and particularly in terms of the self-directed learning. So it's much more around expecting the individual to find it out for themselves, I suppose, and supporting them to do so. (Alex Bols, NUS)

Two respondents feel unable to comment on learning and teaching given their lack of direct experience in universities.

The Institute of Physics representative highlights a difference between more theoretical approaches in Europe and more practical approaches in the UK, resulting in different learning outcomes:

> ...most of the rest of Europe treats it in a much more mathematical, theoretical way and a much less practical way. And so what you find is that British graduates are in mathematical terms much less sophisticated than, say, a French or a German graduate. And this is immediately apparent, one sees it all the time. But they can often do things better. So if you put them in the laboratory, they will be much, much better at doing things than perhaps their equivalents in these other countries. (Peter Main, IoP)

7.2.2 Academic perspective

Teaching and learning practices in the two English institutions in this research emerge as less uniform than was the case with Bologna and/or master degree conceptualisations. Observed similarities and differences are highlighted in each section.

7.2.2.1 Course composition

In Institution 1 the master has 90 ECTS and lasts twelve full months. The compulsory elements are:

- Advanced Classical Physics (if not covered in undergraduate degree)
- Mathematical Techniques
- Research Skills (advanced laboratory techniques and computational and numerical tools)
- Professional Skills (four courses on: information retrieval; tackling a literature review; negotiation and influencing skills; interpersonal skills)
- Self-study project (a literature review on a physics topic).

With the exception of Advanced Classical Physics, these are enabling courses aiming to give students necessary tools to fare well in physics and in a research environment (i.e. mathematical skills, research skills and transferable skills). They are targeted to MSc students only, while the rest of the programme builds on the fourth year of the integrated master. None of the physics courses (6 ECTS each) are compulsory, giving students freedom to take the programme in the desired direction (5 or 6 options to choose from over 20). The thesis work happens for three-four months during the summer.

As to ECTS allocations, taught courses amount to 42 ECTS and research training to 48 ECTS (36 for the master project, 6 for the research skills course and 6 for the self-study project).

In Institution 2 the master has 180 credits corresponding to 90 ECTS, split equally between the project and the courses. Courses have 15 credits each (7.5 ECTS), meaning students take six courses out of a total of over twenty options. The research project is the only compulsory element of the degree. It is therefore students who decide on their specialisation within the broad choice offered by the MSc, described by one lecturer as 'a sort of catch-all'.

Therefore, in terms of course composition, both programmes are similar with a ratio of about half taught and half research elements. Students have freedom to construct their study programme by choosing among a wide range of physics courses. Institution 1, however, includes formalised research training besides the thesis in the form of a research skills course and a mini-project based on a literature review. It also includes compulsory components aiming to strengthen students' mathematical and transferable skills, whereas in Institution 2 only the thesis is compulsory. Thus, research and transferable skills are more systematically addressed in Institution 1.

7.2.2.2 Learning outcomes

In both institutions learning outcomes emerge from teachers' accounts as a well-understood tool embedded in practices. Academics understand the purpose of learning outcomes as focusing education on student achievement, and they describe courses both in terms of content coverage and student knowledge, understanding and skills:

> It's to learn the subject material, so about detectors and how the design of telescopes and instruments relates to the science, the astronomy you want to do with those. So that's the sort of subject matter. And then there's also the presentation skills and assimilating knowledge and constructing arguments (...) In the syllabus and the course document there are some learning outcomes which are that sort of thing. (EI2.2)

Institution 1 employs the term 'learning objectives', but teachers' explanations of their function and a random examination of course descriptions confirm that these are effectively learning outcomes defining student competences as knowledge, understanding and skills on completion of the course. Course information, including learning outcomes, is available on the internet in both institutions and lecturers are confident that students are aware of learning outcomes.

However, one lecturer finds learning outcomes restrictive because they refer to the capabilities of the average student:

> ...if you pass the thing rather than if you pass it *well*, you're probably able to do more. (EI2.4).

Learning outcomes therefore appear as an element embedded in teacher practices related to course description, reflecting a focus on student learning in addition to teacher input.

7.2.2.3 ECTS

In Institution 1 a change triggered by Bologna was the introduction of ECTS as a step to facilitate the institution's projection on the European scene and the transparency of its programmes. This took place in the year preceding the interviews. The Physics MSc, too, was a response to the Bologna Process. Thus, the programme specification makes reference to the 'significant change across Europe as a result of the Bologna Process' and describes the MSc as a Bologna-compliant second-cycle degree carrying 90 ECTS, of which more than 60 ECTS are at master level.

One lecturer admits not being very familiar to the ECTS system given its novelty. All the others express scepticism for reasons related to its accuracy in measuring student workload. Basing his opinion on British students' study habits, a lecturer believes ECTS is less substantial in the UK compared to continental Europe. According to the yearly ECTS allocation, students should work 35-40 hours a week; however, he believes this is unrealistic to expect from British students. Surveys, too, have confirmed that they do not put this amount of effort into their studies. Another lecturer agrees that students work fewer hours than ECTS indicate:

> Shoehorn is the word that springs to mind. I'd say UK universities have had to shoehorn their courses into the credit system and the sort of notional student that usually works nine hours a day on their learning for nine months for a

> year, I haven't met them yet. So I don't see that the credit system makes a lot of sense (...) The calculations that I saw were not really very accurate. (EI1.4)

Another piece of evidence, albeit anecdotal, questioning ECTS equivalence between England and Europe is the experience of students going abroad on Erasmus. Home students normally report that the same amount of workload attracts a lower ECTS value in Europe, that they need to cover more ground and work harder to get, abroad, the equivalent ECTS they would get at their home institution. The opposite is also true: European students coming to England encounter no difficulties in covering the programme.

Another lecturer thinks that his institution is doing an effort to ensure a proper balance of ECTS internally, however inter-institutional reliability is an issue:

> Exactly how comparable that is between external institutions, I have no idea. ECTS is purely an hours-based thing, so it's extraordinarily difficult, probably impossible, unless you actually knew the institute to say this ECTS is equivalent to that ECTS. I don't think you can do that right now. (EI1.3)

Institution 2 uses the English credit system convertible to ECTS (two credits to one ECTS). Credits did not generate reactions, and interviewed teachers seemed relatively happy with the system. There seems to be confidence in its reliability, although a matter-of-fact attitude is noted in the teachers' opinions that it would be difficult to make the credit system fully accurate. There is no formal collection of information on the precision of credit allocations, but one lecturer mentions that interactions with student representatives would pick up anomalies in workload.

Therefore, a considerable difference has been observed as regards credits, not only in relation to ECTS adoption, but also to perceptions of credit reliability and accuracy. In Institution 1 the adoption of ECTS seems to have raised awareness of study times and ECTS inaccuracy as a time measure; namely there is a perception that English students work less hard than credits indicate, and than continental counterparts. It has also raised awareness of inter-institutional and inter-country variation. In contrast, in Institution 2 credits do not emerge as an issue and accuracy is not seriously questioned.

7.2.2.4 Teaching practices

In both institutions all lecturers identify lectures and problem-solving classes as the core teaching activities. Lectures are expository, based on transfer of information on physics topics, and are complemented by problem-solving sessions illustrating theories and concepts introduced in the lecture. The problem-solving sessions open up space for dialogue with students. The account below summarises this teaching practice:

> In my particular case I have three hours in the same day, so the students are sitting three hours in a lecture (...) According to what is the syllabus for the course I have two hours in a row where I do a lecture, and then a break and a workshop-like session where we discuss problems or they are able to ask questions from what they did in the previous two lectures and we will go in more detail. (EI2.3)

In addition, there are a number of other activities, differentiated between institutions. In Institution 1 other mentioned approaches are research-related, namely the literature review supposed to inform the master project, and the research skills course based on mini-projects:

> ...for some of the other courses, we want them to have more of a sense of what it takes to do research. And doing research is very different from going to a lecture course and having someone tell you things. So it's about planning and approaching unstructured problems where no one has told you how to solve it. And then maybe multiple solutions and in fact what you want to do is try a bunch of these and realise there are good methods and bad methods. And you would like to understand what makes a good method in the lab, and how you do a good experiment, how you test a piece of equipment. (EI1.3)

Transferable skills are not taught in physics modules. However, the master project has a strong skills element, and professional skills courses address information retrieval, literature reviews, negotiation skills and transferable skills. One lecturer points out that these are skills necessary in a research environment:

> We don't want a student that can simply pass exams. We want that, but we want a student that can then use that, go off and do something new with it (...)

> And this also includes all the relevant soft skills, so presentation, defending your work, being able to answer questions in a slightly adversarial environment in front of an audience. (EI1.3)

In Institution 2, besides lectures and problem-solving classes, one lecturer mentions an informal research seminar and another one a case-study looking at a particular piece of equipment, thus real-life applications of physics.

Transferable skills are not formally part of the master curriculum. There is, nonetheless, an optional course offered university-wide to all postgraduate science students on aspects like writing a thesis, interpersonal skills etc. Indirectly, students have the opportunity of developing presentation and writing skills by means of reports and the final project. The online master specification states that investigative skills, computer skills and experimental skills are attained mainly through the project work as well as by interaction with the project supervisor and the research group, whereas presentation and communication skills are trained by one-to-one interaction with the supervisor and interaction within the research group.

Therefore, with respect to teaching practices, the major difference is related to the range of teaching instances and the degree of student exposure to complementary training. In Institution 1 teaching is multi-faceted, comprising lectures and problem-solving sessions for physics modules, compulsory mini-projects and a literature review to develop research skills, as well as formalised training in transferable skills. In Institution 2 teaching seems to consist almost exclusively of lectures and problem-solving classes, research and transferable skills being developed mainly through the project and interaction with the research group. In both institutions, lectures appear to rely on an information transmission model, whereas problem-solving classes allow teacher-student interaction.

7.2.2.5 Student learning

In both institutions students are expected to undertake the following activities: further reading around the topics (although one lecturer specifies it is ‘not an enormous amount’), solving problems and note-taking. A practice highlighted as different from undergraduate programmes is the provision of open-ended information which students are then expected to research further – according to one lecturer this is ’the signature, the hallmark of master's level teaching'. This is summarised in the following:

> Usually what I say to them is not to consider (...) that everything that they need to study is what I'm presenting during the lecture. I give them quite a lot of material for reference and I expect them, once the lecture is done, during the week etc. to go and revise this material so that they have a more in-depth knowledge (EI2.3)

In institution 1 three lecturers indicate handing out lecture notes as a common practice, or the expectation that students should take notes as well, as these form the basis for revision.

Group work is mentioned by one lecturer in Institution 2, namely students being required to do group presentations and solving problems together.

In both institutions, students are expected to already have study skills for independent study and the necessary motivation to drive their learning. They are expected to take the initiative:

> I do expect more to be prompted to give information rather than that I prepare a full lecture and then run through the lecture, sort of 'this is what you need to get out of this lecture'; it's more like 'where are your problems and where do you want to go'. (EI2.4)

Expectations regarding student learning are therefore similar in the two institutions: supplementary reading on lecture topics left open-ended for students to deepen and problem-solving.

7.2.2.6 Assessment

Differences are evident between the two universities regarding assessment practices.

In Institution 1 assessment methods depend on the type of course. *Lecture courses* (physics content) are assessed by a final written exam (unseen). The *research skills* course relies on ongoing assessment as students work on projects, plus a final report and demonstration of a developed software, code, equipment etc. Both student commitment and the end-result count. *The self-study project* is assessed by a written report and a presentation. The *professional skills* course relies on continuous assessment and attendance.

Except for the research and professional skills courses, final assessment is reported as predominant. An element of continuous assessment is present in the marking of problem-sheets and coursework throughout the term for the more mathematical courses (rapid feedback sessions). However, this is for feedback purposes, marks not counting towards the final mark. There is also a feeling that not all students take advantage of these sessions. However, the master programme is believed to facilitate informal feedback thanks to the more interactive character of the courses and the ongoing dialogue between students and lecturers.

The nature of the discipline influences the focus of assessment. Thus, in physics modules assessment aims to test knowledge application and problem-solving skills. According to one lecturer, physics is a numerical science and lecture courses do not have the practical element which would allow a focus on transferable skills. The key skill in physics is problem-solving:

> It's not the kind of course – and I think this is true for many physics courses – where you can really form an assessment which really was a test of skills per se because that might require a practical component which we don't offer, at least not within the lecture modules. I mean obviously within the projects which are run during the summer, for example, there clearly is a very strong skill element and we do assess that. But in a problem sheet you expect students to be able to recall key facts, to be able to apply those to perhaps slightly different situations than they have encountered in the lectures and to make calculations. I mean it's a numeric, a quantitative science. (EI1.2)

In contrast, in Institution 2 continuous assessment emerges as the dominant practice. All teachers mention assessment by coursework. The majority of courses also have an open-note exam at the end, typically counting 40% of the total. Other methods mentioned are presentations and reports. One lecturer describes the assessment methods as reflecting a research environment:

> ...we are moving more towards coursework assessment, essay assessment, or open-book exams. So less strict, you have to learn this thing, but more towards the independent researcher-type assessment. Less schoolish assessment, I would say, more high level. (EI2.4)

The choice of open-note exams reflects a concern with understanding the subject matter rather than memorising facts:

> ... in whatever we test we try to test understanding (...) that's why unseen exams are not so good, we don't want people to learn by heart. Physics isn't medicine that you need to be able to name all the bones in the body. You can look up the details in a book, but you need to understand enough to know which book and which detail you want to look up. (EI2.1)

A focus on testing understanding alongside problem-solving emerges from all lecturers' accounts. Factual knowledge itself appears as raw material, only necessary to facilitate understanding and problem-solving:

> They have to have the content knowledge, in physics they have to be able to show that they can do the calculations, and therefore show that they understand the physics... (EI2.4)

Transferable skills are also mentioned, but to a lesser extent, in relation to the presentation of the research project and the above-mentioned presentations.

Therefore, two major differences between the two universities emerge: the predominance of summative assessment in Institution 1 (although continuous assessment is employed in the professional and research skills courses, and unmarked continuous assessment in rapid feedback sessions) and continuous assessment in Institution 2; and unseen exams in Institution 1 versus open-note ones in Institution 2. As to similarities, both institutions rely on more than one assessment method (exams, reports, presentations, coursework), although these appear more varied in Institution 2. Both sets of teachers highlight understanding and problem-solving as the focus of assessment, and there is a perception that transferable skills are difficult to assess in physics courses.

7.2.3 Student perspective

7.2.3.1 Course composition

In Institution 1, courses and the master project run separately. Courses run until the summer and the project unfolds over the summer months. As shown in section 6.2.4, students feel the degree is rushed, with negative effects on the depth of engagement with learning material and on students' capacity to make informed decisions on their next career step (i.e. whether or not to do a PhD).

Regarding the taught component, students note the wide choice of physics courses and the low number of contact hours, with the ensuing expectation they should dedicate considerable time to individual study. A student also says that students from Europe are unaccustomed to this:

> And I think some of them struggle at first because they've got a lot more that they have to be in university, whereas here it's very little time that you have to be here, you should spend the time doing work by yourself. (EI1.1)

In students' opinion it is the length of the project that distinguishes the one-year master from the two-year European one. Whereas the project unfolds over the summer only as opposed to around an academic year in two-year master programmes, the taught component is of similar duration:

> …because we're working over the summer it really is a sort of year-long taught course which has a project at the end, so what they've done, they've taken the two-year master course and just contracted the project. So I guess it's all about what does that extra year do compared to a three-month thing? (EI1.2)

As to the three-month duration of the project, opinions vary as indicated in section 6.2.4. All students agree that the project's primary aim is to develop students' research skills, however there is less consensus on the function of the research output itself. Some see it as an opportunity to get research training, whereas others would prefer it to last longer so that it can be developed into a useful piece of research.

In Institution 2 there is no clear delimitation between courses and the project; students can start the project at any time, by Easter at the latest. They feel that despite having started to work on the project early on, they could not dedicate it much time, courses appearing more imperative:

> I think it was the project that suffered earlier on, because from an undergraduate degree you're more prepared to do the taught modules – they seem more urgent because there's an exam and because there's coursework all the time. They kind of took precedence at the time (...) Whereas I think if you had a clear separation of the two, it would allow you to spend more time focusing on one or the other. Definitely since the exams my project has advanced an awful lot more than it did before the exams. (EI2.3)

As in Institution 1, the choice of physics courses belongs entirely to the student. None are compulsory. The taught element of the master is a similar experience to the undergraduate degree:

> ...the lecture side is very similar to the undergrad, there's no real difference there. It's the project that distinguishes it from an undergraduate degree (EI2.3)

One criticism related to courses is the timing of all exams in the summer, including those for the autumn term modules. This prevents students from moving on, leaving some courses behind, and focusing on the project:

> Because we had all our exams in the summer, even though we did the modules before Christmas, they never really let you forget about them and they were hanging over you. If would definitely have been a lot nicer to get them out of the way and focus on the project more. (EI2.3)

Therefore, regarding structure the main difference students in the two universities experience is the timing of the courses and the project, separate in 1 and partly overlapping in Institution 2. However, despite the longer time-span for the project in the latter, students do not feel they can give it much attention before courses end. The similarity between institutions lies in the student choice of courses.

7.2.3.2 Learning outcomes

In Institution 1 students are aware that course descriptions are available, but accounts suggest a lack of confidence that they fully know what is expected of them. They think mainly in terms of course content. One student refers to covered topics and the vagueness of received information:

> …you are told upfront what things you are going to cover, but you don't really know in what detail. So they might give you a list of things that you should know by the end of your lectures, but if you went to a textbook, you wouldn't really know how much of each of those topics and in what detail you should know. (EI1.1)

In the case of the other students discussion revolves around assessment and the lack of clarity around what it comprises:

> In the beginning I was quite surprised that it's actually allowed to give an exam without writing down what the topics are. So I can't check whether I know everything for the exam. You see what I mean? If the lecturer tells something in the lecture, and it's just not written down anywhere, and I can't check what I should do, if a lecturer is not giving lecture notes, nobody can prove whether a question in an exam is actually allowed or not. (EI1.3)

Therefore, judging by the students' comments there is little awareness of course learning outcomes. Moreover there is concern that lack of information might be detrimental in assessment.

In Institution 2 students are aware that information about course learning outcomes exists and they know where to find it. They refer to what they are expected to be able to do or know rather than to course content.

However, the extent to which they find information on learning outcomes useful varies. One student finds it 'very useful for revision, very useful for preparing for lectures' (EI2.2), whereas another one values more the insight he gets from actual practice through coursework and feedback, rather than from course descriptions:

> I haven't paid much attention to it. I think it was far easier to work out what you had to do by the coursework they gave you rather than reading out instructions, you know, a list of things you should be able to do. I found the feedback from the coursework handier for that. (EI2.3)

Thus, it appears that students in both universities are aware that information exists on learning outcomes. However, in Institution 1 they appear to understand them as topics covered in the courses; what stands out is unawareness of what is expected of students (with implications for assessment). In Institution 2 students understand learning outcomes as expectations of student achievement. However, there are split opinions about their relevance, with coursework and feedback sometimes serving as better indicators of teacher expectations.

7.2.3.3 ECTS

Credits failed to engage students in dialogue. Although Institution 1 now employs ECTS, students are not familiar with the system and do not appear interested either. One student makes the remark that all courses are allocated equal credits, although they may require varying amounts of student work. In Institution 2 students were not familiar with ECTS.

7.2.3.4 Teaching

Students' experience of teaching is similar in the two universities, comprising lectures and problem-solving. The former are described as expository, with little teacher-student interaction. Problem-solving classes ('workshops' in Institution 2) are more interactive, allowing two-way exchanges and student input:

> It's all set up where the lecturer just regurgitates whatever's on his piece of paper, or writing on the blackboard and you copy down. It's the problem classes where you usually ask the questions, very little in the actual lecture. (EI1.1)

> It's mostly the lecturer lecturing us and speaking, there's not an incredible amount of student interaction in the actual lecture itself, but people still ask questions. The workshops are far more interactive, the lecturer would come

> and ask each individual person questions, and if they've had problems with the homework. (EI2.3)

Apart from this traditional combination, one student in Institution 1 mentions occasional talks by external people, and two students in Institution 2 refer to an activity where they have to do a presentation on their project to the research group:

> …through the master course itself you have to give a lecture about half an hour on the research you're carrying out. You have to present a poster and then you answer questions. (EI2.2)

All students in Institution 2 mention the low number of students on the courses. This facilitates a close relationship with teachers, confidence in approaching them ('you can knock on their door anytime'), and dialogue and interaction in and outside the classes.

As mentioned in section 7.2.2, transferable skills are addressed in Institution 1 through compulsory courses. These provoke different reactions. One student finds them essential in physics, described as 'not the most social and talkative environment' where 'because there are so many people without communication skills, you can easily survive without' (EI1.3). However, she deems skills crucial in a competitive environment where one must be a good communicator, for instance to get funding or disseminate research. She thus criticises the low emphasis on skills in physics. Another student makes appreciative comments about the courses, as he feels they make the degree well-rounded. At the other extreme one student describes them as:

> a box-ticking exercise, so they can say 'yes, certainly, our postgraduate students have definitely got interpersonal skills because they've taken the interpersonal skills course'. (EI1.2)

Apart from the transferable skills courses, students believe there is little opportunity to develop soft skills:

> We had to do two presentations in my whole year of about 15 minutes and I think I've worked in one group for about a couple of weeks. And I'm afraid that's about it. (EI1.3)

Institution 2 offers transferable skills courses, but they are not compulsory. During physics modules, given the reliance on traditional teaching methods and assessment by exams and coursework, students feel they have little opportunity to develop transferable skills. However, the research project provides some opportunities, especially through students' inclusion in a research group. For instance, they have to present their research to the group, thus practising communication skills:

> You can give a presentation on what your research is about to other people in the group or maybe other people in other groups who are interested in your project (...)
> *Have you ever done a presentation?*
> Yes, once before a presentation for my project I had to do a trial run in front of the group.
> *Do you think that master students generally do presentations for those research groups?*
> Yes, from what I've heard, everybody does it in their research groups. (EI2.1)

Students also develop their interpersonal skills by seeking support from the other group members:

> One thing I sort of found crucial in the master is making friends with all the postgrads and having them to be able to help you, because your supervisor isn't there the entire time, so I guess the interpersonal skills are quite key for getting your project finished. (EI2.3)

Thus, students in both institutions experience teaching in similar ways. It centres on lectures and problem-solving for physics-specific courses. The teaching of transferable skills is formalised in a compulsory course in Institution 1, but students appreciate it differently. In Institution 2, transferable skills are developed through the research project and inclusion in a research group. In both institutions, students claim that traditional teaching approaches prevent a focus on soft skills development.

7.2.3.5 Learning

Further reading around lecture topics and problem-solving are the main learning activities students in both institutions experience. Hand-outs (sometimes accompanying lectures) and notes are the starting point for additional individual study. Students describe learning taking place post-lecture, rather than as prior reading on specific topics.

> During some of the lectures we are given reading lists. So we have something to do after the lectures as well as problem sheets. (EI2.2)

In both institutions students receive a list of recommended books where additional information is available, but it is up to them to search after the lecture. Opinions are divided about the extent to which further reading around the topics is essential beyond the lecture notes forming the basis for revision. According to a student, one could probably manage by having read only the lecture notes, whereas another one feels that these are not sufficient to understand a topic in depth, being only a guide:

> The lecture notes, sometimes but not always, they will be incomplete, as they may not fully explain a topic, or they won't explain something in enough detail. Some of the courses, there's not enough time in the lectures to go through all the material. So you have to go to the library and get books out and read around a subject. (EI1.2)

> Some lecturers have a lot of information in the lecture notes, so they print off lots of pages. Some are much more sparse and you need to go and look stuff up. Mostly I feel I don't have to look that much up. I mean I don't feel I have to buy the books for the courses, it's enough just to refer to it every now and again. (EI2.3)

A student remarks that reading is very loosely directed, and it can be difficult to find the needed information. She compares this to practice in another European country where there is a limited number of core texts covering all the topics addressed in a course. In England, searching for information can be challenging:

> The main difference is that in here we don't have books. So you get a list of about 20 books and you will be able to find every topic in one of the books, but in [country] you get one, maybe two books, for a course and everything they teach you should be in the book. So you should always be able to find it in one or two books and we are normally supposed to buy the books, so you're sure you have all the information to prepare for exams, to learn

> everything they are telling you during lectures (…) In here, the only thing we have is lecture notes and sometimes you don't even have lecture notes. They just write on the blackboard, or they tell you a story and you should be able to make notes and know what you should learn (...) So I have my notes and if I don't understand I have to find a book and read a bit more about it (…) For one of my exams I spent more time trying to figure out what I had to learn and where I could find it. And I think that's a bit silly. (EI1.3)

As to consulting research literature (papers, journal articles etc.), this does not appear to be common in the courses, but only during the thesis. In Institution 1 students also have to search for articles and papers during the literature review exercise, whereas one student in Institution 2 says that he had to find papers to help with solving problems:

> For the problem sheets in particular, a lot of the stuff we did, we had to actually go and look up papers on the subjects and things. We weren't told where the information would be, it was down to us to do it. (EI2.2)

In contrast to further reading which may or may not feel essential, problem-solving appears central, as the following statement suggests:

> I start out by going over my lecture notes, and just making sure I read everything. I make a smaller set of notes of things that I need to know for that course, and I just go over all the problems, and then I get two or three of the textbooks out and normally there's problems in the textbooks and I do that, because that's mainly what they are assessing you on. They don't ask you to define this definition and you write it down. Normally it's just maths questions that you have to do. (EI1.1)

Students' learning experience in the two institutions is therefore very similar. Key learning activities are problem-solving and further reading. Lecture notes form the basis of post-lecture further study. There is recommended reading, but exact sources of information are not indicated; it is up to students to search for the information they need. Research literature (papers, articles etc.) does not seem to be consulted much outside the thesis work. Student opinions about the extent to which further reading is necessary vary in both institutions.

7.2.3.6 Assessment

In Institution 1 students identify the final exam as the dominant assessment method employed for lecture courses. This is a written exam allowing the choice of three topics out of six. Other assessment methods are reported for non-lecture based modules: the literature review; small projects in the research skills module; marked coursework in maths.

In addition, students mention the opportunity to hand in problems throughout the term and have them marked. These do not count for assessment, but are only intended as feedback for students to gauge their level of understanding. Students appreciate this practice, as it is indicative of what to expect in the final exam:

> They're giving us a lot of problems throughout the year that we can work on, which is really good. You don't just sit in the exam not knowing what the questions are like. (EI1.1)

However student accounts suggest that this kind of feedback is not something benefiting all students, as there is no firm requirement to hand in; resources might be an issue:

> ...if they forced every student to do all the problems and have them marked, it would always be too much work for the students, but it would also conscript a lot of PhD students to mark all the students. (EI1.2)

> If you don't do anything throughout the course, it is possible nobody will notice. Of course you will get in trouble just before the exams. (EI1.3)

Feedback is also mentioned in the context of practical computing modules open to teacher-student interaction:

> ...most of the computing modules were very hands-on, which is nice, you know working on the computer and the teacher coming around and showing you your mistakes. (EI1.1)

Summative assessment (final written exam) is thus experienced as prevalent; continuous assessment, when it exists, does not count towards the final mark.

Reliance on final exams is sometimes resented. This statement summarises well the assessment methodology in the master programme:

> ...usually, in the majority of courses you do problems every week and you hand them in, but they aren't for marks. The mark is just for you to know if you make mistakes. So pretty much the only real assessment is your exams, and then in the first term a literature review, second term there's a couple of computing modules that are graded as you go. But apart from the dissertation at the end, pretty much all the marks are in exams. (EI1.1)

All students agree that at master level it is their understanding rather than knowledge of factual information that is tested. One student talks about how teachers phrase and approach exam questions differently, requiring a higher level of understanding, an broad overview of physics, physical intuition and application of knowledge in new contexts. Another student describes the focus of exams as follows:

> ...in physics there's a lot of concepts that are very hard to get, so I think the exams test your understanding of something more than just repeating facts (...) So this is why you need to read the lectures and understand and look in textbooks, because it's not about repeating the lecture notes, or repeating something that has been told you, because it hasn't been told you, you need to understand it. (EI1.2)

However, the short time allocated to exams is criticised as counterproductive to understanding and deducting the logic necessary to solve problems, meaning that students sometimes have to rely on memory to get results fast:

> ...the time is that short that I can't do the derivation again. So I have to rely on everything I know, I remember, instead of kind of figuring it out again. (EI1.3)

In Institution 2 assessment is described as marked coursework throughout the term and written exams. It appears that most courses either use both methods simultaneously, or are only assessed by coursework. Only one student mentions an instance in which a course was assessed by a final exam only:

> ...some courses are 100% coursework, so we work through problem sheets every week or every two weeks and the marks for that count as the mark for

> the course. Other courses are sort of 60-40 between the exams and the problem sheets. We'll be doing problem sheets throughout the term, which count for 40%, and then we'll do an exam at the end of the term, which counts for the remaining 60%. (EI2.2)

Continuous assessment is thus a widespread practice. Students value the insight it gives them into their level of understanding and appropriateness of learning approach. They all have appreciative comments about feedback:

> …the assignments are marked very fast, and maybe the next week we will discuss the problems and the mistakes in the tutorial class. (EI2.1)

> I think the best thing about coursework is that doing the coursework gives you feedback on how you are doing, if you understand the course well enough. If you're just doing the final exam, it is a bit unnerving in a way. You don't know how much you understand and how much work you have to put in. (EI2.3)

There is consensus among the students that it is their understanding of physics that is assessed through exercises requiring knowledge application, rather than their factual knowledge or memorisation, as the following statement suggests:

> There are the odd times where you will be asked questions with facts you must remember, but most of it is how you build something from the theories you've learnt (...) For an exam, rather than just state equations or something, you were given a system, so you define something called the actions for a system, which is equations about how it works and then you have to work through and derive and build on these. It's not just something you remember (...) You actually have to use most of what you've learnt throughout the course just in one question. (EI2.2)

Thus, whereas the students' experience of teaching and learning is similar in both universities, it varies regarding assessment. In Institution 1 it is predominantly summative, relying on final written exams with the exception of complementary courses. Marked coursework throughout the term, but not contributing to the final mark, is a means of providing feedback. However it is not compulsory and therefore does not benefit all students. In Institution 2 assessment is predominantly continuous and formative and students express very positive views about how constant feedback helps them evaluate and adjust their learning. As to the focus of assessment, there is consensus between the two sets of students that it is their physics understanding and intuition and skills in applying knowledge that are tested in the master degree.

7.3 Portugal

The outstanding aspect about Portugal highlighted in Section 5.3 is the association of the Bologna Process with a new student-centred pedagogic paradigm. The presence of a marked pedagogical dimension to the changes is evident at national political level in official documents, and at institutional level in innovations in academic practices and in the student experience.

7.3.1 National perspective

As shown earlier, it appears that academics were the first to recognise Bologna as an opportunity to introduce student-centred approaches. This grass-root phenomenon was subsequently captured in legislation and other official publications and communications. For example, Decree-Law 74/2006 acknowledged that institutions had already begun adapting their courses to the new organisation model for HE, the first objective being listed as 'the transition from an education system based on transmission of knowledge to a system based on the development of competences' (MCTES, 2006b).

As with the other countries, the various dimensions providing an overview of learning and teaching are addressed in turn.

7.3.1.1 Course composition

Decree-Law 74/2006 regulates the proportion between taught and research (or independent) components in a master degree. The cycle of studies leading to the award of the degree must comprise: 'a specialised course, consisting of an organised set of curricular units' corresponding to a minimum of 50% of the total number of credits and 'a scientific dissertation or an original work project (...) or a professional work placement' corresponding to a minimum of 35% of the total credits. Moreover, degrees must demonstrate their appropriateness by means of 'a comparative analysis between their organisation and the organisation of other renowned European courses with similar objectives' (MCTES, 2006b, p. 36). The concern with the comparability of course structure illustrates the desire of alignment to European patterns.

7.3.1.2 Learning outcomes

Student competences are given extensive attention in official documents. Competences (rather than learning outcomes) is the term employed for the outputs of the educational process in terms of student development. For instance, Decree-Law 74/2006 makes repeated mentions to the centrality of competences in the new organisation of studies and states that ‘a core issue in the Bologna Process is the transition from a passive education paradigm based on the acquisition of knowledge to a model based on the development of competences, both generic – instrumental, interpersonal and systemic – and specifically associated with the training area’. Each of the three cycles is then characterised with respect to the envisaged student competences based on the Dublin descriptors.

Consensus is registered among national level interviewees that employing learning outcomes has been difficult to embed in Portuguese academic practices, given the tradition of describing courses with reference to content. Accounts suggest that despite teachers having gone through the exercise of setting course learning outcomes, they have not understood their purpose and have not internalised the concept. Interviewees thus describe the transition to learning outcomes as ‘difficult’, ‘very slow’ and not occurring very smoothly. The student representative, for instance, refers to the lack of alignment between learning outcomes and assessment methods:

> There are several people that are extremely excited in saying they have renovated things, they are changing things, and then when you explore a little bit further (…) if you ask them ‘How do you prove that? Give me a couple of learning outcomes’. ’Being able to speak, being able to do this, being able to do that’. ‘And how do you assess?’, ‘We have an exam.’ Ok, there’s something missing. You should be able to actually prove that they have reached those outcomes. (Bruno Carapinha)

National actors’ accounts thus suggest that learning outcomes are neither a clear concept nor an adopted practice among Portuguese academics.

7.3.1.3 ECTS

Further to commitments to implement the Bologna Process, Law 42/2005 made ECTS compulsory. These are assigned as a measure of student workload including contact hours, hours dedicated to individual study, internships, projects and assessment (Ministério da Inovação Tecnologia e Ensino Superior, 2005, p. 2). A full-time academic year consists of 60 credits.

According to Decree-Law 74/2006 a master degree comprises 90 to 120 ECTS. Institutions must determine the student workload for each curricular unit and survey student and staff opinions to ensure correct attribution.

No clear positive or negative opinion about ECTS emerges among national level interviewees. Two respondents describe it as better than the previous credit system based on contact hours. However, the ECTS calculation for courses is also described to have been done simplistically: either based on the previous credits, or by simply dividing the total number of credits for the semester among the number of courses offered. However, whereas all criticise the way in which ECTS is currently used, two of them point to its potential as a pedagogic tool to address inconsistencies between the effort teachers believe a course demands and real student effort:

> ECTS could really be a tool for them to learn to say: maybe we are doing something wrong here, because the students in the third year are saying that they are working, I don't know, 2500 hours or 3200 hours a year. How can that be? It's not possible. So maybe there's something wrong here. And the same students were balanced in the second year and in the first year. So, maybe we are doing something wrong. Let's re-plan, let's assess, let's see how things are going. And I mean they just look at it as something that we impose on them, that they need to do it, and solve, it is bureaucracy, paperwork. (Bruno Carapinha, Student representative)

7.3.1.4 Teaching, learning and assessment

Legislation and official documents contain no detail on pedagogic dimensions of study programmes, leaving it to institutions to decide on practices. Decree-Law 74/2006 describes the development of student-centred approaches as a challenge, stating that 'identifying the competences, developing the adequate methodologies for accomplishing them and implementing the new model are the challenges that higher education institutions must face' (MCTES, 2006b).

In an attempt to monitor this challenge, Decree-Law 107/2008 requires HEIs to publish annual reports on the progress achieved in the implementation of Bologna objectives, with an emphasis on the change of pedagogic paradigm, i.e. changes to methods and practices employed in curriculum design and pedagogy. The reports must contain staff and student contributions from surveys sounding the implementation of objectives (MCTES, 2008a, p. 5).

The concern with a pedagogic shift is thus evident. National actors' views on teaching and learning at master level also reflect a preoccupation with student-driven education understood as:

a reduction of directed learning and an onus on students to study independently outside the classroom, i.e. through project-based learning:

> You tend to give students more and more autonomy. You need less contact hours, you can involve your students more in research projects, it's easier because they have a level already, the kinds of knowledge and competence that it's easier to do some work, not just having to follow around to be sure that they don't do many mistakes. So I think the change is in that direction in terms of more autonomy, greater capacity to be involved in different projects. (Sebastião Azevedo, BFUG)

...and students' freedom to construct their study programme as opposed to rigidly defined courses:

> Students should have more flexibility in defining their ultimate curricula. And this again has been done in many parts of the world, namely in the Anglo-Saxon countries, not so much in continental Europe or Southern European countries where the curriculum is very much fixed and pre-established, also at the master level. (Manuel Heitor, MCTES)

There is confidence among all research participants that changes in teaching and learning have taken place in Portuguese universities further to the implementation of the Bologna Process. Practices mentioned as innovative are, for instance, problem-based learning and teaching, diversification of assessment methods and continuous assessment, more flexible curricula, attention to transferable skills:

> I think that the changes are significant in fact. And people are beginning to think in different ways, and more and more – if I listen to different people who are relatively traditional in a way – talk about horizontal skills, the need for graduates when they finish to be able to express themselves correctly, or discuss things or learn by themselves and so on. The problem is that people still don't know how to do that exactly. But I think that the discourse and the idea that is needed is passing. Ok? It takes a long time. (Pedro Lourtie)

Despite 'modernising forces' acting in universities, change is described as happening 'in pockets' rather than widespread. Changes are also described as sometimes cosmetic. One interviewee points to the lack of clarity over what Bologna is and to different pedagogical interpretations as responsible for the uneven developments in Portuguese universities. Hence the need for dialogue to reach a common understanding:

> ...lots of changes were really cosmetic changes, but lots of institutions are trying to change in terms of essence. The problem is from my point of view that different institutions have different concepts about what Bologna is and you hear the phrase 'Bologna is such and such' and they are convinced that that's really the essence of Bologna, and different people are convinced of different things. So I think there's a need for socialising these issues. (Pedro Lourtie)

Another criticism is the lack of pedagogic training for academics, described as researchers who teach. Hence a need to develop pedagogical skills through peer observations, mutual collegial feedback and training:

> I think a very good programme for the Portuguese system and for many other European systems would be massive contribution from the government to introduce pedagogic skills, pedagogic training, pedagogic support to all professors in the university sector. (Bruno Carapinha, Student representative)

Despite their benefits, new pedagogical practices are nonetheless criticised for having attracted increased workloads for academics:

> ... we must have very nice subject descriptors, we must have a very nice dossier, and that is much more paperwork. So professors are now being asked to be much more teachers (…) So from that point of view the requirement for the professor is much higher. Continuous evaluation is a lot of work, which is a problem for professors, and I'm a bit critical, because university professors have many other important things to do. I'm not saying as a liberal profession, I'm not saying to earn money. I'm saying as university professors they have other important duties, such as research. (Sebastião Azevedo, BFUG)

The expectation to change the pedagogic paradigm through the implementation of Bologna is therefore evident in official documents and the discourses of national level interviewees. The latter also suggest that change is underway, albeit slow, patchy and hindered by a lack of understanding of what student-centred education means in practice and by a lack of pedagogic training for Portuguese academics.

7.3.2 Academic perspective

The importance attached to Bologna is immediately obvious in the web pages of the two degrees considered here. Both master programmes are presented as Bologna programmes, thus explicitly signalling their organisation according to the principles of the Process.

7.3.2.1 Course composition

In Institution 1 the master has two profiles, theoretical and experimental, and students choose the desired specialisation. To facilitate the comparison with the other degrees, the theoretical profile is considered here.

The programme specification indicates 45 ECTS for the thesis, or just over a third of the programme. It is allocated half the third semester and the full fourth semester. One respondent describes the thesis as intermediate between the previous final licenciatura project and the previous master thesis.

The remainder of the programme (75 ECTS) consists of ten courses, half of them compulsory and on physics topics, and half electives. Advanced topics taught previously in the fourth year of the licenciatura are now incorporated into the master. As opposed to the previous system, Bologna degrees now allow for some degree of student choice. This encompasses areas beyond physics as well (mathematics, computer science, etc.) further to a university decision that students should have majors and minors. There are mixed opinions about the widening of the scope of studies; some welcome it as broadening students' horizons, while others criticise the dilution of the physics foundation:

> …we have a degree on astronomy, astrophysics, and it has of course a physics part. And it's not even mandatory that students have as many subjects on modern physics, like quantum mechanics, as they should. It's optional now because of this ability that they have. So I don't think that's very good (…) you can get to the end of the three years without having the proper background on the subject that you're supposed to major in. So I think that's a little bit of a problem. (PI1.6)

The compulsory courses are Advanced Quantum Mechanics, Complements of Statistical Physics, General Relativity, Complements of Condensed Matter Physics, and Quantum Field Theory. As to electives, students can choose from around fifteen.

In Institution 2 the master concentrates on solid state physics. Nonetheless, it aims to give students some freedom in fine-tuning their specialisation. The weight of the thesis is 44 ECTS, and it is dedicated about half of the third semester and the full fourth semester. The rest of the programme (76 ECTS) comprises courses, but the programme specification indicates a higher proportion of compulsory elements than in Institution 1, amounting to almost two thirds. Just over a third are electives; however, low student numbers are an obstacle to students' desired options – this would mean giving courses to very few students.

The compulsory courses are Mathematical and Computational Methods in Physics; Complements of Quantum Mechanics; Complements of Solid State Physics; Optic, Electric and Magnetic Characterisation Techniques; Current Physics Topics; Advanced Topics; and Quantum Technologies. The pool of elective courses contains about ten. The course specification states that reference programmes in Europe have informed the course structure for mobility, internationalisation and collaboration purposes.

Therefore, as far as course composition is concerned the two master degrees are similar. The relatively high proportion of compulsory courses and constraints on student choice represent the main difference from the other programmes in this research. However, in contrast to pre-Bologna degrees, programmes now allow for some degree of student input in curriculum design.

7.3.2.2 Learning Outcomes

Both programme specifications indicate the learning outcomes for the master as a whole. However, course descriptions show a different picture: learning outcomes are listed in Institution 2, and only very vaguely in Institution 1.

In Institution 1 a scrutiny of course specifications reveals the confusion over the concept of learning outcomes. For each course there are three subsections: objectives (*objectivos*), competences (*competências*) and learning objectives (*objectivos de aprendizagem*). Intuitively one would expect the second or third category to deal with learning outcomes. However, *learning objectives* without exception lists the course contents. The section on *competences* usually lists general competences such as theoretical understanding, problem-solving, advanced knowledge, communication skills, which could count as generic learning outcomes. The section *objectives* usually comprises a couple of general bullet points on what the course will address, sometimes from an input perspective (e.g. introduce Statistical Physics of non-equilibrium), sometimes with a focus on student output (e.g. learn physical concepts within the Science of Materials). In the case of one course only, the objectives are presented as detailed discipline-specific learning outcomes. It thus appears that learning outcomes are still little understood or employed in practice.

Teacher accounts suggest that course learning outcomes were defined as a necessary administrative exercise rather than a conscientious one. It is not clear, however, how they conceptualise learning outcomes; in answering questions about how they used learning outcomes, respondents either did not understand the question or started referring to course contents. A possible reason for this might be, of course, unfamiliarity with the English term. However, the extended dialogue around learning outcomes seems to suggest they are not familiar with the concept; neither is it embedded in practice. It appears that the rationale of using learning outcomes as tools aiming to facilitate the re-focusing of pedagogy on students has been missed:

> *How about learning outcomes? Do you work with learning outcomes?*
> How? What? How do you define them? (...) You mean sort of the aims of the course?
> *Yes, so what are the outcomes for the students in terms of what they have learnt after the course, and then the assessment sort of refers back to those.*
> I think so. It's more the contents, I think. I define that and at the end you are expected to have knowledge about these topics and I try to make the exam... not only the exam but for instance these problem sheets in order to train them, you need some training to repeat calculations, to be able to do them quickly and also to discover by yourself different ways of solving. (PI1.2)

In Institution 2 course descriptions identify learning outcomes. Descriptions give details on course objectives (usually general presentations of the course, sometimes touching on learning outcomes), on contents, and on competences. It is under competences that course learning outcomes are listed. They appear conscientiously defined, suggesting the concept has been understood.

However, the dialogue with academics reveals a different reality. Apparently setting learning outcomes was carried out as a bureaucratic exercise further to the necessity to submit programmes for accreditation. It appears that the purpose of learning outcomes as a tool for student-centred pedagogy has not been assimilated. When asked how they describe their courses and whether there is any mention of what they expect students to achieve, respondents still invariably refer to course content as a list of topics. One of the respondents does say nonetheless that the course description mentions the expected achievements of students, but he finds them neither detailed, nor useful:

> In principle we have a list of the topics, the classical list of topics, and sometimes a list of possible projects, possible teams. Usually we write the main goals of the course, but it's just a short, not very detailed description of what the goals are; a general description.
> *Are the goals written in terms of what the students should be able to learn in the course, what they should be able to do by the end of it?*

> Yes, but it's not so detailed, I don't think it says something very useful, because it's not very detailed. (PI2.5)

This analysis suggests that the concept of learning outcomes has not yet been understood by the Portuguese academics in this research. Although course descriptions appear to indicate different levels of understanding and embeddedness in the two institutions, the discussions with academics reveal a similar situation of low awareness of this pedagogic tool. This might also be indicative of learning outcomes as a change on paper rather than in practice and conceptions.

7.3.2.3 ECTS

Both master programmes consist of 120 ECTS, the upper limit specified in legislation. One ECTS equals 27 hours of student work. Courses have different allocations: 7.5 in Institution 1 and 6 in Institution 2. Both programme specifications provide detailed information on ECTS distributions between different types of teaching and learning activities, and make explicit the amount of contact hours, usually between one third and a half of the total student workload. In Institution 2, the programme specification states that adjustments have been made to courses and to the distribution of hours between different components further to teacher and student surveys.

In both institutions it appears that ECTS was allocated by equally distributing credits among courses. However, some courses continue to be more demanding and time-consuming than others. In Institution 2 accounts suggest that assigning ECTS based on course objectives and scope was not a realistic option. Since courses are shared between degrees, having different ECTS values for different courses would have made difficult the task of summing up exactly 120 ECTS. Therefore attempts are made to adjust workload to fixed values. Students are surveyed to check accuracy, but response rates are disappointing. Overall, there is some scepticism that ECTS values can be assigned to accurately reflect workload:

> You adjust the teaching to this principle of uniform distribution of workload to avoid the problem to have specific courses with one workload, others with another workload and then you have to combine these courses such that the sum is 30. This is difficult arithmetics for us, so we avoid that (*laughter*). So in

> the end it's difficult to find the meaning of ECTS, in my opinion, but it's maybe controversial. (PI2.5)

In Institution 1 especially, ECTS is viewed with scepticism as a tool which only indicates that students have passed the courses which entitle them to a degree. It only scratches the surface and says nothing about the level of exigency of courses. This is a widespread perception, and respondents believe that further aspects need to be considered to judge a course: curriculum, difficulty of examinations, standard and tradition of university, calibre of students and teaching staff:

> I was in charge of this Erasmus/Socrates programme in the faculty and I still am in the physics department. So I've had some contact with ECTS, especially for students who went abroad. And I think it's difficult to take that too literally, sometimes it does not represent the same amount of work, and one tries to compare the programme, what is taught, the level, looking at the bibliography and things (...) So I think it's useful as an indication, but I don't know... The students don't work the same number of hours, it's not true (...) some people really work more than 40 hours a week and some work much less. (PI1.2)

Teachers on both programmes speak of around 20 contact hours a week, representing a reduction of previous contact time. This seems to have affected primarily problem-solving classes and feelings are mixed. Although a welcome occurrence in theory (i.e. more responsibility on students to work independently), some perceive it as a limitation as the reduction requires a change in student attitude, which is felt will not happen overnight:

> I think that's the most, let's say, sensible point of Bologna. It's trying to achieve that transition from students working in class to working at home (…) I don't think that the reduction of contact hours was at this stage, maybe later it will be, a good idea....It's ok with good students, but not so good students... It's difficult for them to adapt. (PI2.1,2)

One lecturer thinks that too many hours are dedicated to lectures and the balance should shift more towards individual study or, even if contact hours, towards more interactive activities. However, colleagues do not sympathise with this view, feeling that the hours are all necessary to address the subjects thoroughly:

> I would put a smaller number of hours in these lectures which are more formal type of seminars or something like that, and perhaps more hours for private work or something like that (…) I suggested that, but the other people in general would not agree. They said it was good to have these many hours to work the subjects in more depth. But the workload in contact hours is not heavy. It's less than 20 hours a week. But I would prefer less time in these more lecture-type hours and shift a bit to...even within contact hours, perhaps more informal, working in groups and other types of things. (PI1.2)

Summing up, ECTS values are distributed equally between courses and workload is adjusted afterwards. There is reserve about ECTS accuracy, and especially in one institution it is seen as a weak, incomplete indicator of course standards. On the positive side, it appears that assigning ECTS values to courses has led to a rethinking of the time students spend studying, to the redistribution between learning activities, a reduction of contact hours and more emphasis placed on individual self-directed learning. Nonetheless, this is not universally believed to benefit student learning.

7.3.2.4 Teaching

In both universities the dominant practice is a mixture of lectures and problem-solving classes. The former are expository, whereas the latter allow teacher-student interaction. Both sets of lecturers speak of a new strategy to encourage students to take more ownership of their learning, namely only partially presenting topics and then letting the students develop their knowledge and understanding of the topics in more depth:

> I changed my experience... if I need to discuss a subject, I don't discuss completely, or extensively the subject as before. Probably before it was a more expositive discussion that I made full (...) Now I don't do that, I try more to leave gaps that they need to fill. (PI2.1,2)

> The other thing I introduced in my courses... I propose at the beginning of the course a reading programme (...) And I ask them that before they come to the lectures, they know already what I'm going to speak about. And then the classes are used for speaking about topics, details. (PI1.3)

Academics mention other innovative practices demonstrating a shift towards student-centred pedagogy:

- problem-solving driven by students, at home or in class, rather than the teacher as previously:

> Now I am asking them that they solve the problems in the class and they give them back to me and then I will give them again to them corrected. I don’t want in these classes to go to the blackboard and solve the problems for the students. I want that they can be active in the classes. (PI1.3)

- group-work and student debates and discussions:

> I divided the students in groups of two and the problems were assigned to the groups. So I encouraged them to discuss between themselves and I think they usually did (...) I think if I do it again I’ll try probably to modify some of the lecture, to transform it into sort of debates, suggest a topic and try to moderate a discussion between the students. (PI1.2)

- student presentations, i.e. seminars for students in the process of thesis-writing to present their work to colleagues to experience situations a researcher would encounter:

> I don’t think that is being very widely done in the department, but I have a plan for a master degree subject in which I stated that I would like one third of the practical problem sessions to be dedicated to the students presenting...a journal club, a seminar on the subject. That also occurs with some frequency, students who are involved in some project work, in the thesis, are often requested to present a journal club to the community. (PI1.5)

In Institution 2 the emphasis on research-related tasks and project-based teaching emerges strongly from teacher accounts:

> We can give them some problems, more project work, and just say: go and study these articles, and search on this subject, and search for some other books, and try to see what was done in this subject, what has to be done,

> what people don't understand and what needs to be understood and how you can improve your knowledge on such and such subject and come back and discuss with me, and maybe I will have some idea, something for you to do, some activity. So we expect interaction. (PI2.5)

In relation to transferable skills, Bologna appears to have exerted some influence. In Institution 1 skills development is now specifically targeted through a course in the first year of the licenciatura. In Institution 2 increased attention to the development of transferable skills, particularly presentation and communication skills, is a change sometimes attributed to Bologna.

However, in neither master programme is there formal skills training. Students acquire transferable skills indirectly by means of writing reports and delivering presentations on articles, reports, their work etc. Particularly in Institution 2 teachers say they employ activities specifically meant to develop students' transferable skills. The most commonly cited ones are written and oral communication and interpersonal skills:

> We don't have specific courses to develop specific soft skills, but we expect that they can develop these soft skills as they are doing this project work, and when they are doing presentations, also when they are discussing with the professors and they learn by example the way of thinking. So it's just a kind of indirect learning, not direct. (PI2.5)

> Students are not just required to do an examination, but in many of these subjects they write papers on some of the experiments they did (...) Usually when they write these papers they have to present them orally and so get trained in the skills of presentation and things. We don't have specific activities to teach them, say, writing skills. That usually comes from the interaction with supervisors of these activities. (PI1.5)

In Institution 1 soft skills appear as an element that fits uncomfortably within physics. It is to problem-solving that some teachers immediately refer when asked about skills:

> It's a language that we have a bit of trouble working with, because in physics basically you're supposed to solve problems. And your skill is to solve physics

> problems and you can say lots of words about it but that's the bottom point. And in that sense you basically just have to understand concepts and most of the understanding comes by solving problems of growing complexity. (PI1.1)

In summary, teaching revolves around lectures and problem-solving in both institutions. There are testimonies of innovative teaching practices characteristic of student-centred pedagogy in both degrees. Besides, in Institution 2 teaching stands out through its project-based nature and research-specific tasks. Acquisition of transferable skills happens indirectly through activities such as presentations and report-writing. Institution 2 seems more receptive to the importance of skills, whereas in Institution 1 problem-solving is described as the skill characteristic of physicists.

7.3.2.5 Student learning

Student learning is portrayed differently by the academics in the two HEIs.

In Institution 1 student learning consists of further study around lectures and problem-solving:

> They would be expected to come prepared, or (...) have worked on the material that was taught in class when they come to the class solving problems. And that they would try to solve those problems. (PI1.1)

Reading is mentioned by the majority of academics. Research literature, and students searching for literature themselves, is referred to twice. One academic mentions essay-writing on a research topic followed by a class presentation (as initiation to a research environment):

> I always encourage students to write an essay on a topic which is a mixture of my own choice and their own choice and to give an oral presentation before the class, a PowerPoint kind of presentation, 20 minutes, half an hour, where they show what they've done and where they discuss at the end with me and with the class their work. And most of these are based on research papers, so I try to encourage them to go a bit beyond the syllabus of the course and to go into some topic that can be seen as a present research topic, so that they can start to understand what they want to do or not want to do. (PI1.6)

In Institution 2 only in isolated cases is learning described by reference to very specific activities (read, solve problems etc.). Usually it is portrayed holistically as research training through tasks associated with research:

> I think in most of the subjects of the master they have to choose a topic off a certain list, they have to do research on that topic, even in a specific subject. They have to talk to the professor about it and they have to present it. That's basically what I expect from my students: attending classes, doing research, well in a subject it has to be very focused research as they don't have a lot of time, write a report, present to colleagues and to professor. (PI2.1,2)

Thus, learning in Institution 1 is presented as problem-solving and reading (with some mentions of research literature), whereas in Institution 2 it is portrayed as happening through research-related tasks.

7.3.2.6 Assessment

The two degrees also display differences in the assessment practices employed. Summative assessment based on final exams is the norm in Institution 1, whereas continuous assessment and reliance on a variety of assessment methods is common in Institution 2. This is also evident from course descriptions.

In Institution 1 a random look at several course descriptions reveals the written exam as the most employed method. Sometimes assessment also includes some evaluation of student work. All lecturers, too, mention the final written exam as the most widespread form of assessment. When combined with other methods, it receives the highest weighting in the final mark. It also overrules all other marks, should it be higher than the average of the continuous assessment marks:

> It's the final exam, yes. Sometimes we do tests in the middle, so we somehow force them to study more continuously (...) So we do tests that count also for the final mark. You can do some assessment like written papers and presentations, I don't do that much. What I've done more is several tests during the semester so they would keep studying. But even if you do that, by the rules of the faculty, if they come and do the exam and have everything correctly in the exam, they have to have the maximum mark. So it's still the exam, the important thing. (PI1.4)

Nonetheless, most teachers say they now combine the final exam with other methods which count towards the final mark, such as a small project and a quiz, problems, several tests during the course, an essay followed by a presentation etc. As to marking problem-solving during classes for assessment purposes, one teacher felt it was shifting the attention from learning to assessment, thus being counterproductive to student learning. The same teacher also reports that consideration is given in final exams to student effort and progress throughout the course:

> And in the end, of course, you have written exams. I think everywhere you have written exams in these theoretical topics, but sometimes, very often, part of the assessment is then based on how they do these works, how they do these problems, how they do some little problems they are asked to do. (PI1.2)

Overall, a gradual incorporation of continuous assessment into practices seems to be occurring. This comes out of an awareness that assessment needs to change, or in the words of one teacher 'I try to spread things a little more because it's supposed to be a continuous evaluation':

> I think there are some instances where people do that, they choose a set of problems during the semester and students have to work, and one way or the other that would be taken into account in the evaluation. (PI1.1)

Students' low willingness to do more work throughout the course is a factor that sometimes appears to hinder a shift towards continuous assessment.

In contrast, in Institution 2 assessment takes place in a variety of ways. Course descriptions indicate diverse assessment methods feeding into student evaluation: homework, presentations, final exams, reports, small projects etc. All interviewees, too, indicate that the final mark for a course is the result of a number of assessment methods, of which the final exam (written) is but one. However, judging from course descriptions it still tends to receive the highest weighting. Sometimes there is also a mid-semester exam. One teacher describes the assessment on his course as:

> It's all by essays and problem-solving, not an exam, because if it were an exam they would have to bring books and so on. I trust them to do that at home, so they solve the problems that I would put in the exam and they deliver two essays, twenty pages each. So each of them delivers about 40 pages of work at the end, instead of doing formal exams. (PI2.4)

Continuous, regular assessment is highlighted as a new practice adopted further to Bologna:

> I would say that the general trend was to increase the number of tests, of exams, and to give homework sometimes to the students. To try to force the students to work at home, many times. So previous to Bologna we had several subjects where you would have only the final exam. (PI2.1,2)

In both universities oral exams are exceptional, only available to students who are just under the 'pass' borderline or who wish to improve their mark. This situation is, however, not reported to occur often.

Teachers in both universities report that assessment intends to evaluate students' ability to draw on knowledge and apply it to find solutions to new problems. Physical intuition and understanding of physical processes and laws appears as the other dominant aspect that is tested. Factual knowledge is unanimously seen as a tool which can facilitate understanding, but not an aim in itself:

> I think mostly it's the capability of the student to grasp the kind of questions that were made and the analytical skills that he was able to display in working out the problem. So it's not strictly content knowledge in a sense because you don't ask him: What is the Dirac equation? You don't ask questions like that generally in this physics department, you put the students in front of problem situations, sometimes inspired by research, sometimes inspired by a simplified version of some kind of calculation that the person has come across in the literature and we often see how the student fares in that thing. (PI1.5)

Transferable skills taken into account in assessment appear to be those linked to research: oral and written communication, presentation skills, research abilities:

> ...at the master what we do more is these oral presentations (...) Of course it's taken into consideration. And then it's problem-solving, writing assignments, communication to the peers... (PI2.4)

> Ok, let's say I'm assessing a student on a paper that he wrote. Then I have many different things: was he able to really grasp some of the literature that he wrote, was he able to write a consistent story with good references and did he master the subject? So if I'm doing some assessment on a paper which involved reading literature and things, which happens several times during the degrees, then all those skills count. (PI1.5)

Assessment is thus predominantly summative in Institution 1 and prevalently continuous in Institution 2. In both institutions continuous assessment is described as a change triggered by the implementation of Bologna. Assessment tests problem-solving and knowledge application, requiring an understanding of physics. Soft skills are also said to influence assessment, especially those required in research.

7.3.3 Student perspective

The student experiences in the two Portuguese master degrees generally mirror the accounts of the academics teaching on the programmes. Whereas students share similar views on course composition, learning outcomes and ECTS, they report different experiences with regards to teaching, learning and assessment.

7.3.3.1 Course composition

As mentioned previously, courses take up the full first year and partially the first semester in the second year. In both degrees some students resent that the thesis is not allocated a full year, comparing it to the longer thesis in the pre-Bologna master. One student claims that the post-Bologna master invests in heavy teaching to compensate for the perceived loss in the bachelor, with the result that it has lost its research orientation compared to the previous degree. He thus describes it as follows:

> Right now the first year of the master degree is just an extension of the bachelor, because we really didn't have bachelor degrees – they are called licenciatura here – they were 4-5 years long, and now they are only three so

> the master degree right now is just a continuation of the bachelor to have the full five years. So it's more like a taught degree. I think that before it was more like a preparation to do a PhD than it is now. (PI2.1)

However, students feel, too, that the courses are essential to consolidate their physics foundation, equipping them for the upcoming thesis work:

> I really believe that the courses we have and all we do before the thesis – which ends up being the most important part of our master, being almost a year – it is necessary so that we then manage to do a good piece of work. (PI2.4 - translated from Portuguese).

Course choice is criticised in both institutions. In Institution 1 most students complain it is limited – despite a large number of options, few advanced physics courses are on offer:

> I think that in terms of options, at least in the theoretical side, you don't have too many advanced physical subjects to choose. You have plenty of subjects you can choose in mathematics. You have also the freedom to choose from different subjects, not necessarily physics. But I think there is a problem, there is a lack of advanced physics subjects, at least in the theoretical side. (PI1.1)

In addition, one student complains about the unfeasibility of taking their preferred options because of logistical issues and schedule overlaps.

One criticism appears surprising. A student resents increased student freedom to choose courses and design their curriculum. He believes students do not have the necessary level of knowledge and competence to make informed course choices, best suited for their future career. He attributes this to the Bologna Process:

> I wouldn't approve of Bologna at all because of the freedom that it gives us. I wasn't here before Bologna in my master degree, of course, but I believe that before Bologna there was a specific path for us to follow. And that path was studied and analysed by professors and people with more experience than us. We don't really have the knowledge to do those choices correctly,

> because I don't know if my curriculum is very good at the end of my master degree based on the choices I've made. (PI1.2)

In Institution 2 the small student numbers on the master invalidates choice, as that would mean offering courses to one or two students. Thus in practice there is no choice, as all students take the same options:

> We have 4-5 disciplines per semester. Some of them are called options: option 1, 2, 3 and so on (...) But since we are only like five people in the master we cannot choose from those disciplines, so we have to take one of them. Otherwise, we would be one in one of them, and one in the other. (PI2.1)

To sum up, students in both universities resent the diminished weight of research in the master further to a shorter thesis and a teaching-intensive degree compared to the previous master degree. They are also critical of the range of electives for various reasons: lack of courses of interest, logistical obstacles or small student numbers. Thus, although in theory the curriculum now allows student choice, in practice this is often unfeasible.

7.3.3.2 Learning outcomes

There are no differences in the two universities in the students' experience and awareness of learning outcomes. They were asked whether they knew what they were expected to know, to be able do and achieve by the end of the degree or of specific courses. Most refer to course descriptions in terms of contents and topics:

> We have a content table and based on that we try to know what we need to do, what we need to know how to do at the end of the semester. (PI1.2)

> It's like a book index, it has everything we have to learn by topics... although it was more organised during the bachelor than it is during the master. We had one or two professors who didn't really have a script, although I think it was mandatory to have a script. And we need to have access to it since the beginning (...) That script is also available on the internet. (PI2.1)

Other students understand the question in more general terms, namely their awareness of the programme's orientation and opportunities the degree would open up. They criticise the clarity of information they received at the beginning, as the following extract illustrates:

> I was informed what I will do when I chose the master programme here, but it wasn't very, very well explained, like I can see now in the final of the master. I wasn't expecting some of the classes I had, so I wasn't so well informed.
> *So what were you not so well informed about?*
> I wasn't very aware what I would do with a master here. (PI2.3)

Students' lacking awareness of learning outcomes indicates that the balance has not yet shifted to an emphasis on student achievement in programme conceptualisation and design; it is still on the teacher's input into the educational process.

7.3.3.3 ECTS

Both sets of students are familiar with the fact that ECTS measures course workload, and they report to have answered surveys on the time they dedicate to each course.

In Institution 1 all students disagree that ECTS values are accurate reflections of workload. Although all courses get 7.5 ECTS, some require more work than others:

> I don't think it's a very good way of evaluating the time you spend studying because for instance in the master all the disciplines have the same ECTS. But it's not true that you have to spend the same time equally in all subjects. There are subjects that need more work. (PI1.1)

In Institution 2 opinions on the accuracy and relevance of ECTS are mixed. One student cannot comment, one feels that equal ECTS values reflect equal amounts of effort, whereas one feels the system is still not properly implemented, ECTS being assigned superficially as a standard number.

Scepticism appears thus widespread about ECTS accuracy among students.

7.3.3.4 Teaching

Student interviews reveal different teaching experiences in the two HEIs. In both universities, students mention the traditional lecture centred on teacher input: 'just a normal class, the professor exposes the subject on the board' (PI2.1).

In Institution 1 one student suggests that problem-solving can also be teacher-centred:

> …we have also practical classes in which for instance professors in previous days deliver you some problems, and you are supposed to try to solve them before. And then (…) there are two kinds of professors: the ones that want to solve the problems on their own, and the others that expect you to solve the problems on the blackboard and discuss with the class. (PI1.1)

A difference emerges concerning problem-solving classes. Students in Institution 1 report to have them, whereas in Institution 2 a student says that problem-solving sessions do not exist in the master as teaching units, with students expected to do it at home. Instead, all students in Institution 2 refer to teaching and learning through research-oriented tasks and small projects:

> In principle we have a focus on articles and to develop them, we read them and do some similar works to articles. I think we work well, maybe we could do more in some disciplines. (PI2.3)

In Institution 1, beside the scheduled classes, there are regular research seminars and journal clubs which students can attend, but these are perceived to be of rather high level and difficult for students to follow:

> ….there are several seminars and journal clubs that you can go to. They invite people from outside, but most of the times, at least in the journal clubs, it is mostly in-house people that are speaking. At least the journal club works one day per week. And there are also seminars (...) so you can attend them. But at least in the theoretical side, there are not many introductory seminars. Most of the seminars are already too technical, so a master student attending the seminar or the journal club, most of the times it's not easy to follow. (PI1.1)

Student accounts suggest that in Institution 1 student-centred activities are not common. One student also says he has not noticed a difference between teaching approaches in the undergraduate and the postgraduate degrees. Another one criticises the formal, traditional style of teaching:

> Maybe the teaching approach, the conventional lecturing, maybe we could try more informal ways. Teaching, but through dialogue, I would say (…) And move a little bit away from the conventional, that would be a nice initiative, maybe it would give more efficiency in the teaching process. (PI1.4)

In contrast, some students in Institution 2 make reference to the close relationship with teachers on the master, to working together, and to an interaction conducive to students' experience of the degree as apprenticeship and initiation to the discipline:

> ...in some way we're going to know better the professors and know how life works in physics and somewhere we get more motivated that that's what we're going to do, and I think we get a better perception of what we are doing here. (PI2.3)

As to transferable skills, some students in Institution 1 believe they have developed interpersonal and communication skills during the thesis. Most feel they have had insufficient training to feel confident in their presentation abilities, although on occasions they have had to present homework or reports (one student has presented in the journal club mentioned previously):

> ...we have works we have to present orally. For example homework and other kinds of reports and stuff. But I don't think that's, well, it's not regular enough for me to feel that it would make a difference. (PI1.2)

Students in Institution 2, in contrast, feel satisfied with the opportunity they have had to develop oral communication skills through repeated exposure to presentations. One student also talks about having developed research-related skills, i.e. literature search and retrieval of information.

In summary, the classical lecture seems to be the one teaching method experienced by both sets of students. Beyond that, students speak of different pedagogies: a teacher-centred approach predominant in Institution 1 (teacher sometimes assuming centre stage in problem-solving too; few student-centred activities; high-level seminars challenging for students to follow etc.) and a student-centred approach in Institution 2 (teaching through projects and research-focused tasks, hence onus on students to drive learning; close relationship with teachers; and teaching experienced as initiation to professional research). Students in Institution 2 also appear more satisfied with the opportunities they have had to develop transferable skills.

7.3.3.5 Learning

All students in both institutions mention reading literature in preparation for lectures. Most agree that lecture material conveys information only partially, students being responsible to fill gaps in their understanding. This practice is described as particular to the master:

> The professors prepare some matters that they want to teach us and then they teach us sometimes just the beginning for us to continue. And that's the difference between the master degree and the degree because in the degree they tell us everything, now they just say where it begins and we shall make the rest by ourselves. (PI2.2)

In Institution 1 students say they complement lecture notes with further information they have to find in books. Some say it is uncommon for them to read papers, as teaching is not at such an advanced level:

> …basically in the beginning of the year, the professors are telling you which books they are following, so they give you lecture notes, or you pass the lecture notes from the blackboard. In the lecture notes there is still much that is missing, it doesn't give you everything, so you're supposed to go to books and search the internet, papers – well, papers not too much because the level is not so high, you don't have to go to papers because everything is in textbooks. (PI1.1)

In contrast, in Institution 2 most students say they need to consult research literature and publications as part of the course reading:

> ...we are supposed to find some publications, read some publications to be up to date and read about state-of-the-art. (PI2.3)

Students in Institution 2 also talk about learning through small projects.

Problem-solving is only mentioned by some students in Institution 1 and one in Institution 2.

Students highlight the need for dedication and a self-driven approach to studying, essential given the above-mentioned teacher practice of expecting students to fill in information gaps. Students also describe proactive attitudes, for instance a student gets involved with research groups outside his curricular obligations, and others form study groups by own initiative:

> ...in my free time I go to different groups of research and ask what I can do for them in order to learn more, but that’s totally extra-curricular. It doesn’t have anything to do with the master degree. (PI1.2)

> ...in recent years students, they do work in groups, they exchange ideas and they try to tackle the problem talking with each other and exchanging views. They have a more group-oriented approach. (PI1.4)

Students thus suggest that learning consists mainly of reading to complement lectures, as these do not provide full information. The scope of reading varies, research literature being mentioned primarily in Institution 2. Here learning through projects is also referred to. Problem-solving is mentioned less than expected. Students highlight autonomy and pro-activity in learning.

7.3.3.6 Assessment

Students experience one key difference: the prevalence of summative assessment in Institution 1 and of continuous assessment in Institution 2.

All students in both universities agree that the most common assessment method is the written exam, usually without textbooks. In Institution 1 this is the final summative assessment, only a minority of courses requiring regular homework submission which counts towards the final mark:

> I can tell you that in ten subjects I have three subjects in which you are actually supposed to work regularly and deliver. (PI1.1)

Besides, two students mention that in one course they had to prepare a presentation. Written assignments (i.e. essay or report), are mentioned twice. One student, however, confirms that the essay and the presentation were in the same course.

In Institution 2, in courses evaluated by written exams students can choose to split the assessment into two tests, one midway and one at the end. Alongside written exams, presentations based on research topics are mentioned across the board. According to a student, there has been a shift from exams in the first year to assessment methods based on research tasks and projects in the second year:

> During the first semester of the second year we had to present publications, we had to present some other stuff, so it was different. It was not based on exams like the standard procedure, so we had to do more work by ourselves. We had to do some research at home, we had to present, so I think it is important to prepare a student for a research career. It's better than the exams. (PI2.1)

> ...we had several small group projects during the last semester, so most of the disciplines were assessed by that kind of projects. So (...) we had to do like three small research projects for a discipline, and another two for another. While during the first year we were assessed by exams, during the last semester we had that method. (PI2.1)

Homework makes up only a small fraction in assessment.

In both universities the oral exam is used when students fail an exam very closely as an opportunity to get a pass.

In both institutions students only experience formal feedback at the end of the course through the mark. Informally, in Institution 1 some students feel they get feedback after submitting homework in the courses which employ this practice. However, one student states that in physics feedback is not so important, as you can easily see what you did wrong:

> I don't think it's important, because we know when we are doing right or wrong in the physics case. We know when we are doing an exercise if it's the correct or the wrong way. (PI1.3)

In Institution 2 the close relationship with teachers as well as continuous assessment facilitates informal feedback according to some students.

Students feel that teachers value students' understanding of physical principles, their physical intuition and reasoning, rather than acquisition of factual knowledge. Knowledge is valuable when applied to new situations:

> ...we have to adapt ourselves and to apply knowledge, we have to transfer the knowledge to new problems (...) We have to memorise some things, or else we would know nothing. But it's more based on understanding things than just memorising, that's the good part of physics. (PI2.1)

In Institution 2 where assessment also happens through presentations, students feel that their soft skills are hardly considered in assessment.

Thus the widespread assessment practice in Institution 1 is the conventional final written exam as a summative assessment method, but a few courses are starting to employ alternative methods. In contrast, in Institution 2 the general feeling is that continuous assessment and a variety of methods predominate (two tests, presentations, small projects etc), although the written exam is still identified as the most common. A shift to assessment methods based on research tasks and projects has been noted in year two. Assessment tests student understanding and ability to apply knowledge. Feedback is synonymous with the final mark; other than that, it is experienced informally through continuous assessment or homework submission (when this is employed).

7.4 Denmark

7.4.1 National/political perspective

In Danish universities the Bologna Process appears to have changed practices tangential to teaching. The introduction of learning outcomes and ECTS in study programme descriptions is identified by all national level interviewees as a Bologna-related consequence. Their implementation has been steered by actions at the national/political level, i.e. regulations and firm requirements. Legislation also gives rather detailed provisions on aspects like course structure, programme specifications, assessment, etc. However, these do not appear to be linked to Bologna.

7.4.1.1 Course composition

The 2004 *Ministerial order on bachelor and master's programmes (candidatus) at universities* regulates the weight of courses and thesis in the master, as well as the proportion between course components within and outside the disciplinary specialisation. Components within the chosen subject area ('elements basic to the programme's particular academic competence and identity') must correspond to minimum 90 ECTS, including a thesis worth 30 ECTS (or up to 60 ECTS if experimental). The order also envisages a broad curriculum beyond the boundaries of the main discipline through a provision stipulating minimum 10 ECTS points for an elective subject.

Student input into programme design is reinforced by the stipulation that the modular composition of programmes must ensure that students are able to choose between skill profiles relevant to a variety of professions.

In setting these conditions for course composition, legislation thus highlights the importance of a flexible curriculum. It allows students to design a degree suited to their interests, both within the discipline through modularisation and student choice, and also beyond through the presence of elective subjects.

7.4.1.2 Learning outcomes

All interviewees describe the inclusion of learning outcomes in programme specifications as one of the changes with most impact in Danish universities. The 2004 *Ministerial order on bachelor and master's programmes (candidatus) at universities* states that programme specifications should indicate 'academic and vocational skills acquired during the programme'. The requirement to revise programme specifications (*studieordninger*) based on learning outcomes shifted the focus from input components of a degree (i.e. content) to student learning output. According to the Ministry representative, the detail of implementation was left to universities. They only received general guidance in the form of the qualifications framework and a letter from the Ministry with a firm timeframe to complete the exercise:

> ...they had a letter from the Ministry and the Danish Qualifications Framework, and it said you have to implement this. You have two years and then we have to be able to see it in your *studieordninger*. So that was a demand. Except from the Framework, there was no saying exactly how they had to do it, and it was also implemented differently. But it made quite an impact. (Anne-Kathrine Mandrup, Ministry)

The revision of programme specifications is acknowledged by several national interviewees as an enormous administrative task which required a lot of effort:

> All universities had to revise the descriptions of the different degrees with the learning outcomes. That was when I was still in a university actually... That really meant a lot of work and it was a big process for everyone to go through re-writing the descriptions of all degrees according to the Bologna guidelines. (Rikke Skovgaard, DU)

While acknowledging the impact of learning outcomes, some interviewees highlight variation in their embedding in institutional programmes and practices, suggesting variable implementation:

> I think some really embraced it and used it, some made their own terminology and changed it, and some said we use it, but it didn't have a great impact on the *studieordning*. So there were different kinds of strategies. (Anne-Kathrine Mandrup, Ministry)

> I do not think that a lot of teachers are aware of a certain recipe, if you can say so, how to get there, that they, to some extent, are still doing what they have done before. (Michael Huss, Agency for International Education)

Despite the concept of learning outcomes being introduced in Danish academia with the Bologna Process, the pedagogical idea of student learning rather than teacher input guiding the educational process was already being discussed pre-Bologna, as testified by several national actors. Bologna's contribution was to articulate this pedagogical concern with student learning which had not necessarily been conceptualised earlier:

> I was working in the EVA[15] evaluation before in the 90s. And I think a lot of the evaluation also discussed what the students should learn and things like this. It was issues that were discussed already at that time, so I think we might not have used the term ‘learning outcomes’ because it’s not a Danish term – it has been translated now – but I think there was a huge focus on not only writing down what the student should learn, what books to read, but also why should they read this, you know. So there should be a coherent picture why we do this. (Anne-Kathrine Mandrup, Ministry)

7.4.1.3 ECTS

The attribution of ECTS values to programmes and degree modularisation are identified as new institutional practices triggered by the Bologna Process. ECTS was made compulsory in 2001, and the 2004 Ministerial Order reaffirmed its use as a programme descriptor. Similar to learning outcomes, some describe it as a significant administrative endeavour. However, others do not perceive it as a big change since a credit system (*årsværk*) existed before ECTS. Thus the concept was not new altogether. As to implementation and use, some believe that although initially it was done superficially, universities are now employing ECTS correctly:

> ...of course, when you change from one system to another there are always some perceptions from the old system that remain. You don’t have like, from this and this date we have ECTS and everything that was before is now forgotten and now we have implemented the new system perfectly. Of course there will always be a phase where you have the perceptions of both systems being there at the same time. But I think it’s becoming a more and more reliable indicator of workload and what to expect from a course. (Rikke Skovgaard, DU)

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[15] In the 1990s the Danish Centre for Quality Assurance and Evaluation of Higher Education (established in 1992) evaluated all higher education programmes at university as well as at non-university level. Two agencies are now in operation: the Danish Evaluation Institute in charge of evaluation and accreditation of short and medium cycle programmes and ACE Denmark in charge of long cycle university programmes.

The ACE Denmark representative and the student representative are the divergent voices. They feel that ECTS is far from representing accurate reflections of student workload:

> Some places you have to work 70 hours a week to get a certain amount of credit points and at another institution, or just at another course, you might only have to study 18 hours a week to get the same amount of points. So unfortunately it's not at all reflecting the workload. But that's also very different, some places, some institutions have been very good at implementing the credit system, but a lot of them have the same workload that they've always had. (Lena Scotte, DSF)

7.4.1.4 Teaching, learning and assessment

While praising the Danish tradition of learning through projects, the OECD review encourages further growth in project work and internships in curricula, invoking employability objectives, i.e. graduates 'adequately prepared for productive employment in a knowledge-based economy' meeting demands for good communication, analytical and problem-solving skills. Simultaneously, the review criticises reliance on formal lectures and recommends training academics in effective teaching alongside the promotion of best teaching and learning in universities (OECD, 2004, p. 14). An emphasis on university education relevant for the economy and on curricula mindful of student employability is thus noted. This is also present in the government's globalisation strategy. Indeed, the Ministry representative confirms that a consequence of the implementation of the two cycles has been increased attention to employability and transferable skills and greater flexibility for students to pursue a career, in light of the possibility of changing programmes after the bachelor.

Whereas there is little reference to teaching and learning in legislation, assessment is thoroughly regulated. The *Ministerial Order on University Examinations and Grading* (Ministeriet for Videnskab Teknologi og Udvikling, 2004a) stipulates in detail the conditions applying to examinations as regards objectives, assessment methods, evaluation, certificates etc.

National interviewees describe their views of master-level teaching and learning very generally, referring to the following aspects: a teaching style encouraging independent learners who take ownership of learning; problem- and project-based approaches; specialisation. Two of them highlight that pedagogy lies within institutional remits:

> I think it has to be fitted to the purpose of the subject, what the students should learn and the number of students. So I don't have many things to say about that, it's for the universities. (Anne-Kathrine Mandrup, Ministry)

This illustrates the existence of different foci of concern at different implementation levels (national-level policy actors and implementers of practice in institutions) – a natural occurrence, indeed. Nonetheless, Oddershede points to Danish universities' risk-averse nature and to the high regulation present in Danish legislation. According to him, detailed specifications do not provide a lot of space for institutional decisions. However, in his view universities do not necessarily resent this, as more freedom is synonymous with making more mistakes:

> It should be said that the universities' own administrations are sometimes sceptical about having fewer rules: rules are fixed points and when they are removed, more decision is passed on to the local decision-maker. This provides the individual university and its departments with more freedom to act, but at the same time it increases the risk of mistakes and decisions being made that can lead to criticism (Oddershede, 2010, p. 4).

7.4.2 Academic perspective

This section is informed by the interviews with academics in the two Danish Physics MSc degrees considered in this research and by the programme specifications. It is worth noting that both specifications list the laws under the jurisdiction of the Ministry of Science, Technology and Innovation in accordance to which they have been drafted, thus signalling compliance with national legislation. Overall a great degree of similarity is noted in the learning and teaching practices employed in the two degrees. The analysis addresses both degrees simultaneously, but wherever there are differences these are discussed.

7.4.2.1 Course composition

In compliance with legislation, both programme specifications state that physics components must amount to 90 ECTS, while the elective or optional subject components are prescribed to 30 ECTS. Within physics components, the thesis is regulated to minimum 30 ECTS, but it can amount to 45 or 60 ECTS depending on the extent to which it is experimental and on the number of chosen courses. However, in both institutions teachers say that the thesis tends to be in the upper range of 45 or 60 ECTS.

The organisation of the year is also similar, with four teaching blocks in Institution 1 and four quarters in Institution 2. The number of courses taken in one teaching block/quarter is different: two in the former versus three in the latter, however the ECTS allocations for courses – 7.5 ECTS and, respectively, 5 ECTS – give a total amount of 15 ECTS per teaching block.

One difference is the presence or absence of compulsory courses. In Institution 1 none are compulsory. Students have to choose a certain number out of a specific group of courses – what a lecturer describes as the 'Chinese restaurant model where they have to choose four things out of a list of 8 or 10.' Attempts at faculty level to make the department introduce compulsory courses have met staff resistance. In Institution 2 there are three fixed courses: Electrodynamics, Advanced Mechanics, and Student Colloquium (students giving lectures on a specific topic before their fellow students to develop presentation skills). The remainder are electives and there is a wide range of courses to choose from (around 60-70).

In both institutions academics feel confident in the students' maturity and ability to pick courses suited to their interests. Therefore they advocate full student freedom to tailored study programmes to their needs. Students can decide on the degree of specialisation. Under the guidance of a supervisor they normally choose courses relevant to their chosen specialisation which can inform the thesis.

In both universities the taught component of the course and the project are combined flexibly. Students do not necessarily work on the master project at the end of the degree only. They can have courses running in parallel with the thesis work. As one teacher explains, if they do for instance a 30 ECTS thesis they may actually start already at the beginning of the second year, but with a relatively low thesis activity in the autumn semester, while they still attend courses. They can then dedicate most of the time to the thesis in the spring. So the two activities are often combined. During the thesis students are normally integrated in a research group and work under the supervision of a tutor. However, thesis work is carried out independently.

One lecturer in Institution 1 feels that the thesis is the instance when students grow into fully-fledged physicists; however one year feels too short for that – hence the reality of students taking longer than five years to complete the master:

> ...to come back a little bit to this thesis work, because that's where students start to feel like fully-fledged physicists, and I think it's important that they end up being able to act a little bit like researchers, posing problems and being able to attack them. Maybe a total of five years is somewhat too short for that. (DI1.3)

Nevertheless, the concern with thesis completion in the agreed time-frame is obvious in the thesis contract stipulated in both programme specifications. Students have to sign a contract which indicates a firm submission deadline. Failure to submit counts as a failed examination and a new deadline must be applied for.

Therefore, the outstanding aspect regarding course composition is students' flexibility to design their programmes reflected in the choice of course components, the weight and timing of the thesis, and the inclusion of an optional component ensuring a broad education beyond physics.

7.4.2.2 Learning outcomes

Learning outcomes feature in course descriptions in both degrees. Descriptions address not only physics topics to be covered, but also what students are expected to be able to do by the end of the course. The programme specifications also list student learning outcomes.

During interviews, teachers were asked how they describe their courses and whether they convey in any way what they want their students to achieve by taking a specific course. All respondents referred immediately to learning outcomes (*læringsmål*). Awareness of the concept and its purpose as a pedagogic tool is unanimous.

Learning outcomes are described as a requirement introduced in the past few years, with about half the academics in each institution attributing it to Bologna. The description of practices related to learning outcomes suggests that lecturers have generally defined them conscientiously and found the exercise useful in reflecting on what they actually want students to take away from the course. Despite having initially been met with reserve, accounts generally suggest that learning outcomes are meaningful in the early stages of documenting a course and then during assessment, since grading criteria are based on learning outcomes. However, they tend to be forgotten during the teaching:

> It's useful when you plan a course to sit down and write down what you expect them to be able to do at the end. But other than that I don't think we use them a lot. Then you sort of forget them again and don't use them during the course. (DI1.1)

> Now it's actually not so bad to have them. It forces us to think about what we want the students to be able to do after the course. It's actually also easier to give the correct grades because you write up the objectives and that's the ones you look at when you give the grades. (DI2.1)

There are, however, criticisms of learning outcomes. Although in theory they should enable students to know what is expected of them, in practice there is doubt whether students find them meaningful, and indeed whether they actually read them. One lecturer, fully aware of their function, still finds them worthless, as they appear to him artificial. He is sceptical of the way they are used in practice, and besides finds them restrictive and inaccurate in their definition of expected student achievements:

> They are useless. I 'm sure that the concept can be an extremely powerful pedagogical tool, but (...) I don't think they are working as they ought to do. I don't think the students know more about the course or what the content of the course is from looking at them (...) The exam is in principle supposed to test these *læringsmål*, whether the students have reached those or not. And I don't think – maybe it's our fault – but I don't think the way we implement it, the way I implement it, I can use it (...) I know how I do the exams, I would like to test if they understand. The key word is understanding. What I really want to know from a student is whether they understand the concepts. And I'm not really allowed to put that as one of the *læringsmål*. Understanding is very difficult, very vague in a sense, it's hard to do an objective test of that (...) We're treating the student as a robot when we're writing these *læringsmål*. So we demand that the robot has to fulfil that and that. But that's not testing

> understanding...officially. Unofficially we do it. That's how I see them, it may be a caricature. (DI2.2)

Another criticism refers to a lack of holistic consideration of learning outcomes across courses. These should be viewed globally, beyond course level, to ensure the whole range of student achievements expected from a physics master degree is covered:

> I really think that as an institute we should sit down and decide what are really the important things that we think students should do and make sure that the courses they choose actually address those issues. To be honest, I don't think we've done that (...) I think we could do a better job at describing these goals and making sure we don't address the same core competences in 15 different courses and don't address the other 10 competences in any courses. (DI1.2)

Describing courses in terms of learning outcomes is thus a fully embedded practice and most staff recognise its pedagogical value. However, not all are convinced of their relevance for students and, indeed, that they are used appropriately to serve their purpose.

7.4.2.3 ECTS

ECTS is unanimously associated with Bologna in Institution 2 and partly in Institution 1. Both sets of lecturers express confidence in ECTS reliability in measuring student workload in their own department. They are, however, more sceptical about its use in other universities, countries and even other departments in their own institution. ECTS is described as an approximation to reality in both departments, but students are surveyed and efforts are made to ensure workload is equivalent to ECTS allocations:

> Of course when you see all the courses given here, we know that there is some variation about the amount of work that you actually have to do. But we really try, also when we have feedback from the students – we have it systematically after the course – one of the things we ask is how much time they spend on this course. And we really try to adjust and harmonise. So we try to be strict in that sense. (DI2.1)

However, a couple of respondents in Institution 2 believe that ECTS misses on an important dimension, namely the level of course difficulty and demand. This appears as an obstacle for the comparison and transferability of learning. Whereas this might not be a problem for teachers' experienced eye, for students it is difficult to gauge the level of a course:

> What I think it's missing on this ECTS thing is that it's very hard to get to the actual level of the courses that we are giving here. When we're talking harmonisation, it's some sort of objective marker for what level we have reached and normally for us, who know the field, it would be just going in, looking at the textbook and see what is offered and the level. But that's the way we can do it as teachers. But I don't think students find it very easy to judge the level of the specific course by looking on the web and seeing what we have. (DI2.2)

Therefore, ECTS and learning outcomes as new components of programme and course specifications are in varying degrees associated to Bologna. Escalating administration around teaching has been noted in recent years in both institutions, but there is uncertainty whether or not it relates to the Bologna initiatives, or is as one lecturer puts it 'a local administrative mania that's taken hold', of little benefit to academics:

> I don't know how much it's the Bologna Process as such and how much is the general bureaucracy that's been increasing around the teaching (...) So I have a feeling it may be associated with the ECTS, but we had to do much more careful documentation of all the courses well in advance, and there have been much stricter rules around the courses. We've had to do this extra work. I mean, for us as teachers it doesn't really look as if it has any extra bonus for anybody except for some of the bureaucrats who sit around and look at all the nice programmes. (DI2.2)

7.4.2.4 Teaching

Whereas ECTS and learning outcomes trigger Bologna associations, there is consensus among all lecturers in both institutions that Bologna and the implementation of the two cycles had no influence on their teaching practices:

> We had to standardise a bit our courses, but it was not a major issue. And the way we run courses is practically the same it used to be beforehand, and the way we do examinations is practically the same. Not much has changed. (DI2.1)

The National Students Union representative also describes changes undertaken to re-focus long five-year study programmes into bachelor and master as superficial.

One change associated to Bologna is, nonetheless, English as the default teaching language.

Several interviewed academics have noted a new emphasis on pedagogic competences and student learning in recent years. However, they do not attribute it to Bologna. In Institution 1 this is associated to the government's preoccupation with shorter completion times and the subsequent changes in funding regulations:

> I would say that the teachers in general have become more aware of what the students have learnt before, so they know more when they give a course what actually is the background of the students. That's in conjunction with the requirement that students finish in time that teaching has become more important. (DI1.4)

In Institution 2, beside new funding conditions teachers mention other factors that might be accountable for the pronounced pedagogic focus: staff changes and a different mentality among younger academics, professional integrity and preoccupation to ensure students get the most of the degree, and natural improvement of teaching skills throughout the years.

The combination of lectures and problem-solving classes is unanimously mentioned as the core teaching activity. Lectures develop theory, whereas problem-solving classes deal with theory illustration. Lecturers play a central role in lectures, mainly expository in nature, whereas problem-solving classes are a forum for interaction where students discuss problems. However, lectures and problem-solving are often merged, which facilitates a much more interactive style and a teaching approach concerned with student understanding and application of knowledge to real situations. In Institution 2 this is linked to the small number of students on master courses and the same lecturer delivering both lectures and problem-solving sessions:

> …mainly, courses have mixed lectures and exercises (...) then the lecturer would lecture for half an hour, then he could have handed out a paper on some problem and then a student may have signed up for giving a small discussion, and then they would continue on that for maybe the next hour and then also the teacher could sum up, and then there could be also exercises, more down-to-earth problems to work with the mathematics. (DI1.3)

Alongside lectures and problem-solving sessions, there are isolated mentions of other teaching methods, such as group-work around specific issues which students have to research and present, individual projects on defined topics and experimental lab courses. In both institutions students can trade courses for projects, but this does not appear to be a frequent choice.

Concerning transferable skills, a difference in the approaches employed in the two institutions is evident.

In Institution 1 there are no formal activities or practices targeted deliberately at developing students' soft skills. Lecturers describe the acquisition of soft skills as 'learning by seeing', or 'in an indirect way' through students' inclusion in research groups. It is noteworthy that these skills are mentioned in a research context. For example students are expected to give presentations on their projects to the research group, and there are seminars where they present to their fellow students. The emphasis on communication skills is predominant in lecturer accounts, and some also refer to interpersonal skills. Working within a community of teachers and peers, students become familiar with teamwork, with how to present and discuss science, etc:

> I don't know how they fit in what we do to give them these skills. There are certain skills that are very important, in research everything is done in groups and working in a group is a very important skill. So we try to teach them that during the master thesis where they all are connected to research groups. But it's not formalised in any way. And also being able to discuss science, your particular field, is very important, not to be afraid, to show your own stability and ask good questions. (DI1.1)

Some reserve about the effectiveness of implicit learning practices is present in all accounts:

> I think it's more in an indirect way actually, for example the way students have to sign up to present the content of a scientific paper for their fellow students. That brings a good number of the softer skills into play. But I would say that communication, we could work more explicitly on it. I would say it's more the general attitude of the teachers and the students, say, to engage in open discussions. But I think that especially oral skills, presentation skills, we could work more explicitly on that. (DI1.2)

In Institution 2 transferable skills are addressed through a compulsory course, the Student Colloquium, comprising student-run mini-lectures throughout the semester. It aims to develop students' communication, interpersonal and critical skills:

> At the beginning of the student colloquium course there are a couple of lectures explaining about good practices when you give a lecture, things not to do and so on. And then they are a class of maybe 15 students or so, and then during the semester they have each to give this colloquium on a project which they have probably encountered themselves, maybe looking up in a scientific journal, but they also have to listen to the other students and take part in the discussion and the criticism of the topic. (DI2.1)

In addition to the Student Colloquium, integration in a research group is another means of developing transferable skills.

Teaching practices thus appear uniform in both institutions with lectures and problem-solving at the core of physics-specific teaching. These are often integrated, facilitating a dynamic teaching environment. It is in the provision of transferable skills that approaches are different: implicit apprentice-type learning in Institution 1 as opposed to a tailored compulsory course in Institution 2.

7.4.2.5 Learning

Expectations of student learning are similar in the two master programmes: prior reading in preparation for the lectures and problem-solving.

Lecture courses are based on a textbook as the main reference. In addition, teachers make available notes on the topics they have covered:

> ... you make a weekly bulletin where you write up what was covered last week, what is covered this week, what will be covered next week and so on. So it's not that they have to work independently in the sense that they have to figure out what book to read and so on. (DI2.3)

In this respect, reading is directed. However, there are a few isolated mentions of students occasionally being required to find and read research papers. All lecturers in both institutions report that they expect students to read beforehand on topics that are going to be covered as well as to understand and solve problems before coming to problem-solving sessions.

7.4.2.6 Assessment

In both departments, the oral exam (whereby students draw a topic and have to present it) is reported as the most common or standard assessment method on the master. Presentations based on scientific papers or defined research topics are also mentioned almost unanimously.

Other employed examination methods are reports, take-home exams and written exams. In Institution 2 written exams (essays or problem-solving) are used for courses with large student numbers, hardly the case at master level.

In both universities assessment is predominantly summative. In Institution 2 occasionally there are mid-term evaluations. In Institution 1 lecturers suggest that continuous assessment is gradually gaining ground in an endeavour to create regular study patterns and to shorten completion times, despite the 'hesitance to give credit here for that sort of thing':

> ... we are approaching a situation where the students along the course would hand in some problems which are also evaluated (...) there could be a tendency that the students at the beginning of the course don't work as hard as towards the end, and I think it's good to somehow teach the students to work on a more regular basis. (DI1.3)

Formal feedback consists of the final grade and the discussion after the oral exam in both universities. Otherwise, feedback throughout the course does not happen systematically, but indirectly through problem-solving activities enabling students to test their understanding and teachers to form an idea about each student's progress:

> There is not an evaluation, but there is the possibility of getting feedback during these problem-solving classes with fairly few numbers of students, so if you are participating, it will be revealed if there are some things you have not understood. That's for sure. But this is not mandatory, you can come or you can not come. And this is not affecting the final grade. (DI2.4)

However, one lecturer criticises this approach for leaving it mainly to students to assess their progress:

> I think we're probably not very good at giving feedback along the way, and we sort of expect students to keep track of their own progress and to make sure that they are following the studies well enough. (DI1.2)

The primary concern for teachers in assessment is student understanding of physics laws as well as their ability to apply knowledge to real-life situations and to solve problems. When asked about the focus of assessment (i.e. knowledge, understanding or skills) skills were interpreted as problem-solving skills:

> …you're given the problem and the physical laws, how should you combine them and deduce the correct answer mathematically. And this is the most important, often the most difficult in fact. This is what I mean by skills. (DI1.1)

> The main aim is to get them thinking on their own (…) I'm trying to make them integrate the knowledge they had before with the formalism that we are using in the course. Because if they cannot use the formalism in the end, if they cannot take the mathematics, if they cannot put that to work in practical applications in actual situations, then they haven't learnt anything. Then they've just learnt to recite formulas. (DI2.2)

Factual knowledge therefore appears secondary, serving for problem-solving and applications – hence assessment practices discourage learning by heart:

> At the master's level we really want them to be able to do problem-solving, modelling, putting up mathematical models for physical situations. That's very important. So actual knowledge – because for almost all written exams they are allowed to bring textbooks and whatever they want – it's not that they have to remember, but that they can do problem-solving. (DI2.4)

Assessment is reported to consider primarily the scientific content of the course, and less so transferable skills. However, in oral performances the quality of the exposition influences the evaluation:

> It's clear if you come in and give a very, very good presentation, it makes a good impression. And you can get away with knowing maybe a little bit less. So if you're very good at structuring, and are very good about the points and what you know, and say that in a clear way, that's good. And that's a good thing to learn actually. That's part of the things that I personally aim to focus on with students. (DI2.3)

A preoccupation with writing skills is evident, nevertheless, in both programme specifications as regards the thesis. One states that 'the student's written expression skills must be included in the assessment', whereas the other one goes even further saying that 'if the standard of the spelling, formulation and communication is so poor that it makes assessment difficult, up to one whole scale on the grade may be deducted'. This emphasis on writing skills derives from legislation (Ministeriet for Videnskab Teknologi og Udvikling, 2004a) which states that evaluations must take into account spelling and formulation.

In summary, the oral exam appears as the standard assessment method on the master. Presentations, too, are used widely. Other methods (written exams, reports etc) appear less common. Assessment is predominantly summative, but continuous assessment is making inroads. Feedback is not formalised except at the end of the course. During courses feedback occurs in the context of problem-solving sessions. The main preoccupation is with students' problem-solving abilities, their physical understanding and ability to apply knowledge. Skills evaluation emerges as secondary; however there is particular emphasis on the quality of the written expression in the thesis.

7.4.3 Student perspective

7.4.3.1 Course composition

Students in both institutions talk about the balance between courses and thesis, and about the range of courses on offer. They highlight the benefit of taking several courses before the thesis: they get a flavour of the possible areas they could pursue in depth and can make an informed decision. The typical pattern is one year of courses and one year for the thesis:

> I think I could definitely end up doing this master thesis without taking all these courses before, but then of course I would be more unsecure if I was in the field that I want to be. There's so many different subfields in physics that I think it's very nice that you have some time in trying out different things before you choose your master thesis subject (...) I think it's very nice that we're doing the project for a whole year, it's fun to make a really big project and really feel like you're doing real research. (DI1.1)

Both sets of students highlight the thesis as a distinctive learning experience. However, 'real research' stands out in Institution 1 (as above) and independence and knowledge application in Institution 2:

> It's a chance to get your hands on reality, work on your own, and in that case it's pretty different from doing coursework, going to exams. So it kind of gets more individual and specialised than the bachelor. (DI2.1)

In both institutions about half the students criticise the relevance of some courses, overlaps, and some courses failing to meet expectations. Overlaps are in one instance attributed to students choosing courses in similar areas based on their interest. In Institution 2, one student resents the choice limited to physics courses, or 'hard courses'. For students whose intended career paths involve other specialisations (e.g. teaching), this is constraining:

> I had the freedom to choose whatever physics courses I want, but I would just have liked if I could have chosen classes to be a better teacher. Because most of what I'm going to teach the students is basic knowledge that I've had

> not from my master. The things that I've learnt on my master are very difficult to teach in a high-school. (DI2.2)

In addition to courses and the thesis, students in Institution 1 mention the alternative of doing projects to earn credit.

7.4.3.2 Learning outcomes

In answering the question about their awareness of what they were expected to achieve by the end of the degree or specific courses, with one exception all students in both universities refer to the course documentation which provides details about the knowledge, abilities and skills they will develop during the master and in individual courses. They are aware that this information exists and know how to find it:

> …I know if you look up there's a document describing what the master student in physics should be able to do once he or she finished the master (…) I know in this document there's a list of stuff, abilities that a master student should have. So in that sense, yes. And throughout each course also yes, because we have this system that when you sign up for a course, there's an info page for it before you sign up. And on the info page there's a bullet list: 'the student who successfully completes this course should be able to: blah, blah, blah...' (DI1.3)

However, opinions about the usefulness of learning outcomes are divided. In both universities some students confess not paying attention to them:

> I haven't sort of looked into what's the point of me having all these courses, what it is that I'm supposed to be able to do at the end. I haven't looked at that. I know it's rather easy to read about. (DI2.3)

7.4.3.3 ECTS

Students have different perceptions about the reliability and accuracy of the ECTS system. Their opinions are based on the workload needed for each course in a situation where all courses have identical ECTS allocations. Thus in Institution 1 opinions are split, some students saying that credit values do not mirror actual workloads:

> … some courses I spend 20-25 hours a week working on, and some courses I spend 6 hours a week working on. And I get 7.5 points for both. And I was working full-time in [foreign country] for five and a half months in a research lab, working 10 hours a day. And I only got 15 points for it. (DI1.3)

In Institution 2 most students consider that ECTS values represent workload accurately, judging by the time they dedicate to different courses. However, one student, familiar with the effort courses require at a different university, believes ECTS allocations are not uniform across institutions:

> ...for one course in [HEI] where you get 7.5 points you don't have to do much more than you have to do to get 5 points here. So I think if you compare those two, you have to work harder here to get 5 points than to get 7.5 in [HEI]. I think I just spent too much time to get 5 points here (...) If you compare it to the fact that you have to work like 40 hours a week and you have three courses, you have to spend 13 hours per course, but I spend more than 13 hours on one course. (DI2.3)

Student experience of ECTS thus confirms the difficulty of accurate workload representation and the cross-institution variation in practices.

7.4.3.4 Teaching

The main teaching approach all students identify is a combination of lectures and problem-solving classes. Lectures are based on textbooks (notes are also mentioned by students in Institution 1) and consist of teacher input, while during problem-solving students and teachers work on problems together:

> The professor gives this presentation four times a week, then we have three hours of theoretical exercises where you have problems and the lecturer or the professor will be there – it's not a PhD student, actually it's a professor or a lecturer who helps out if there is problems. Then we do the problem-solving, the students go to the blackboard and present the problem to the other students, then the professor will help out if there's anything wrong or adds to

> the problem-solving part if there's details to be added. And there's a very nice dialogue between the students and the professor. (DI2.4)

In addition to lectures and problem-solving, most students in Institution 1 also indicate the following teaching instances:

- an experimental component: 'you go out and do a specific experiment, and it could be either a big facility, like a neutron facility, or do some research as part of a course' (DI1.4)
- a 'study group' or 'article class' where students give presentations on different topics to their peers
- research seminars organised by research groups.

Students interviewed in both universities are unanimously appreciative of the close relationship between lecturers and students on the master degree as opposed to the bachelor. Small student numbers facilitate a more informal atmosphere, opportunities for teachers to get to know the students and an environment conducive to dialogue:

> During lectures you are allowed to ask questions all the time. If there's something you don't understand you can also go to their office and talk afterwards. And also if something interesting, a new subject has just come up, I would say the programme can be changed, so it's a dialogue, it's widely open, easy to get in contact and speak with the lecturer. And these classes are around 20-30 students per class for the master courses, and that means you kind of know the whole group. (DI1.4)

> The professors are pretty good to listen if you have some critique to the teaching or you have a question. They are really eager to make sure that you understand the material. I think that's a general thing with the teachers here. (DI2.4)

In Institution 2 this close relationship appears enhanced by the lecturer being in charge of both lectures and problem-solving sessions.

The teaching of transferable skills emerges as implicit. In both institutions most students claim to have had plenty of opportunity to develop communication skills through oral exams, presentations to research groups, class presentations, conference attendance etc:

> I definitely think I get a lot of presentation skills from the exams, but also from for example this weekly seminar that I can go to. We are also asked to, during the master, make a presentation ourselves. And have a presentation in front of more people than only the teacher and the censor. So I definitely think my presentation skills have developed a lot and I feel secure in presenting my work in front of other people. (DI1.1)

> There's presentation work stuff done which prepares you for the final thesis exam. Because maybe you have to go out to conferences, you have to present posters and stuff like that. Also in the research group there will be presentations. (DI2.4)

In addition, in Institution 1 most students also say their interpersonal skills have improved by working together with other students in preparing for exams, or working on group projects, or by interacting with other researchers and discussing one's own research. This indicates the social nature of learning in the master degree:

> In preparing for the exam for example I have for several courses worked together with other people about how we do this presentation and present it to each other before the exam itself, and giving critique on how they can improve and how I can improve myself. Some of the calculation exercises have also been a joint venture with other people in preparation for the exam. (DI1.2)

The following statement, however, is illustrative of the primacy in physics of subject-specific knowledge and skills over the development of transferable skills (i.e. communication):

> …we have some training, it could be more, but I don't think it would be easy to do that. And the students are feeling that they are learning enough. If there's too much focus on presenting stuff and writing for people not knowledgeable in physics, I think it would detract from the important part of physics coursework. (DI2.3)

Teaching is therefore predominantly experienced as a combination of lectures and problem-solving classes. Besides, students in Institution 1 mention other activities such as research seminars and study groups. As to transferable skills, students speak confidently about the acquisition of presentation skills through various training opportunities. In Institution 1 students are confident they have developed interpersonal skills, too.

7.4.3.5 Learning

Reading in preparation for lectures is the one activity that all students in both institutions mention. The textbook is unanimously identified as the main source. Besides, in Institution 1 students also mention lecture notes and occasionally research papers or books. The lecture becomes an opportunity for students to check their understanding and ask for clarification.

A student in Institution 1 who studied in another country, too, believes learning is much more guided in her Danish institution, with students getting clear indications where to find additional information. At the foreign institution, students had to identify further sources of information themselves post-lecture, which made the whole learning experience time-consuming:

> Another thing that was very different is that I'm very used to having a book or the notes and I'm very used to having this written pensum, and in [country] we didn't have that in a lot of courses. And therefore you were more expected to learn everything from the lectures and by yourself figure out what you had to understand (…) And sometimes if I would ask professors what I could go and read, then they would maybe give me ten different books and it would be very difficult for me to find a book that was well written and covered the right stuff and also avoiding reading too much about something I didn't have to learn. (DI1.1)

Problem-solving is mentioned by about half the students in Institution 1 and unanimously in Institution 2. In the latter, it appears as the primary activity students engage in:

> a typical course would be that we have a book and every week there's a chapter or two, and of course we have to read these, get a good understanding, and after each chapter there are these problems that we have to solve to get a better understanding of the material. (DI2.4)

In Institution 1 learning through projects is mentioned, too, by about half the students. Moreover, students describe learning in the master as initiation to a real work environment. The physics master becomes an experience similar to an apprenticeship in a professional area, the degree marking the transition from student to professional:

> I have very much gained experience in having a colleague and being in a working place. Before that I was just a student, at the undergraduate level you are just a student and you hang out with the other students and you drink beer and you talk about the exams and stuff. But then as a master student you actually begin to actively be in a working environment that's not just you studying and hanging around with your friends, but some people actually expect you to perform and to have results. And this is something I have definitely thought about, this change between being just a student and being somewhere in this student-colleague limbo as a master student. (DI1.3)

Regarding learning approaches, students suggest that learning is very much an individual matter. They all talk about being pro-active, taking responsibility and steering their own learning themselves:

> …you need to take more responsibility for your own learning on the master's. So I think it's the individuality, I've been learning to work on my own (…) I guess it's pretty important to be able to understand things in physics, to get your answers to how to do it, to try things out by yourself. (DI2.1)

> I don't want to be a 'straight A' student, I just want to learn the things that interest me. (DI2.4)

Thus, the typical learning activities in both universities are reading before lectures and problem-solving. Reading is directed, mainly based on textbooks. Occasional reading of research literature is mentioned in Institution 1, as is learning through projects and experiencing the degree as professional initiation. Problem-solving appears to receive more weight in Institution 2. All students speak about the need of a proactive attitude to learning.

7.4.3.6 Assessment

In both institutions the assessment method identified unanimously as typical in the master is the oral exam described as follows:

> There's an exam, normally we go in and pick a number, then we get the question, then we get half an hour preparation for this question, then we do half an hour presentation on the blackboard on some physical problem. (DI2.4)

Other assessment methods students in both institutions mention are:

- written exams based on problem-solving (unanimously in Institution 2 and about half the students in Institution 1)
- presentations around topics students have to research themselves (about half in each institution)
- take-home exams.

In Institution 1 almost all students mention project-based assignments and written assignments (i.e. papers).

Students in both institutions report that assessment normally only happens at the end of the course, thus being predominantly summative:

> …sometimes you need to turn in a small paper or a small written assignment or do some exercises. But this is not very often. Mostly it's at the end of the courses. (DI2.1)

It is also usually at the end that students get feedback, i.e. after the oral exam, on submission of a project report or a paper. Therefore the students' impression of receiving little feedback on their performance is not surprising. Some refer to problem-solving classes as an opportunity to self-assess their level of understanding or to get feedback:

> I think that the greatest opportunity is the problem-solving classes and then really you see for yourself if you understand it or not. Then you get like a feeling, because before you get there, you try to do it on your own, and if you do everything on your own, then probably you understand things. (DI2.1)

> The teachers are very open to discussion about a subject and some courses also have written problems to hand in during the course that are not actually part of the exam, but a sort of help so that you can see how you're doing. And you can get feedback on those. But there's no real automatic feedback level, but you can get feedback if you ask for it. (DI1.2)

Regarding what teachers test in assessment, all students agree that in the master the focus lies on understanding of physics:

> I'd say at least in the physical sciences it's my impression that the teachers put an emphasis on the understanding of the curriculum, on really internalising the curriculum. So as an undergraduate I feel that I could go through many courses just by being able to calculate and not know anything about the physics. Whereas I think to a higher degree at master level they emphasise internalisation of the physics, which to some extent is I guess a more research-oriented way of teaching. (DI1.3)

> One of the things we have to do is to pick the most important things and present what is most important, how we can describe what is going on without always going into detail, so how is our understanding of the difficult problems. So it's often very directed towards the physical understanding of the problem, not always the mathematical description and do we know exactly what the book teaches? (DI2.3)

In Institution 1 students interpret the word 'skills' as problem-solving skills. This is reported as the other concern in assessment, but mostly in the case of written exams:

> …written exams focus on do I know how to calculate stuff in this subject more than on general understanding. It would in principle be possible to pass a written exam without really understanding the fundamentals, but only knowing how to calculate different kinds of exercises. (DI1.2)

It is interesting to note that students cited above seem to draw a distinction between understanding and problem-solving, the former receiving greater esteem.

Transferable skills do not seem to play a part in assessment in either institution, judging by student responses; however in Institution 2 students say they receive feedback on their presentation performance.

In both departments, therefore, assessment relies predominantly on oral exams, but presentations and written exams are employed too. Project-related assignments and papers are also employed in Institution 1. Summative assessment is the rule. Feedback is given after the assessment. However, students identify problem-solving sessions as an opportunity for feedback during the courses. There is agreement that teachers are concerned with students' understanding of physics rather than factual knowledge, and problem-solving in the case of written exams. Transferable skills seem not to play a role in assessment.

Chapter 8 Implementation of the Bologna Process: Selective acquiescence, creative commitment and strategic conformity

This research builds on the epistemological premise of situated meanings and actions, acknowledging the influence of the context (national, cultural or institutional) on conceptions and practices. Consequently, conceptions of the Bologna Process in the three countries in this research are expected to have shaped engagement with its objectives. This chapter thus aims to synthesise and compare these conceptions and national and academic responses to the Process in order to understand the implementation of the master degree as one of the Bologna action lines (the creation of a cycle system). In analysing the countries' engagement, the chapter considers understandings of Bologna, motivations behind responses to the Process, as well as implementation strategies at national and institutional level. These are diverse given Bologna's non-binding nature and loose policy-making and implementation through the open method of coordination. The chapter places Bologna within the wider context of national higher education reforms and considers the extent to which Bologna appears to have been a driver for changes.

In all three countries the national level understands Bologna as a structural reform aimed at a comparable European-wide organisation of studies. The authorities' response is influenced by the perceived relevance of the reform and its alignment with national priorities.

The speed of reaction to Bologna varies. In England, where the three-cycle system and quality assurance arrangements were already in place, the Bologna Process went relatively unnoticed and there was an initial period of inaction explained by a perceived lack of relevance. As a consequence, England started giving consideration to the Bologna Process around 2004 when faced with concerns, about half a decade after the Bologna Agreement. To some extent early scepticism was also the case in Portugal; in addition frequent changes in government hindered the formulation and pursuit of any coherent political agenda until around 2004. Interest was nonetheless already manifest in institutions (Amelia Veiga, et al., 2005). Denmark, however, appears to have had a clear vision and started reacting to the process early on, as legislation passed already in 2002 and 2003 demonstrates.

The nature of engagement in the three countries could be described as selective acquiescence in England, creative commitment in Portugal and strategic conformity in Denmark. The reasons for, and manifestations of engagement will be summarised in this section. Bologna is grasped as an opportunity by Denmark to internationalise its HE degrees, and by Portugal to modernise its HE system. It was met with indifference and later concern in England. Nationally, Denmark and Portugal used legislative levers to bring about reforms, whereas in England Bologna did not attract any centrally-coordinated initiatives of any kind.

	Understandings	*Key elements adopted (main changes to previous system)*	*Elements seen as inappropriate*
Selective acquiescence	Degree comparability Mobility	ECTS Diploma Supplement (some HEIs on account of institutional autonomy)	Input-based degree descriptors (time) Bureaucratic QAA system Threatened institutional autonomy and degree diversity
Creative commitment	Degree comparability Modernisation through degree reorganisation Recognition Mobility Pedagogic change	Three-cycle system (vs. four previous degrees) ECTS Diploma Supplement Competences and learning outcomes New quality assurance and accreditation	Shorter degree durations Misleading degree names Bachelor as exit degree
Strategic conformity	Degree comparability Internationalisation Recognition Mobility	Reinforcement of previous three-cycle system ECTS Diploma Supplement Learning outcomes New accreditation system	Bachelor as exit degree

Table 8.1 National responses to Bologna

England's engagement is justified defensively. No action is deemed necessary to align its HE system to a structure already based on the Anglo-Saxon model. However, there is anxiety that the Bologna Process might construct interpretations of phenomena and evolve in directions conflicting with English understandings and practices, such as bureaucratic quality assurance, the 3+2 structure or an input-based credit system. It therefore appears essential for England to engage in discussions in order to influence the evolution of the Process, so that it will not turn to England's disadvantage. Bologna is viewed more as a threat than an opportunity, evident in the predominance of concerns in the Education and Skills Committee report on the inquiry into the Bologna Process. Nonetheless, opportunities are also identified in relation to the internationalisation agenda, namely research collaboration and access to a larger market for international students in the wake of the development of the European Higher Education Area (House of Commons Education and Skills Committee, 2007a, pp. 30-32).The primarily self-protective motivations for engagement are evident in the reasons for establishing the UK Europe Unit in January 2004: 'to lobby the UK's position in various European policy-making fora' according to its representative, or 'to strengthen the position of the UK higher education sector in debates on the Bologna Process and EU policy' according to the Unit's website. Engagement at home materialised in the creation of the UK Europe Unit to inform the sector and deal with enquiries, and in participation in discussions and events at European level. Simultaneously, comprehensive English HE reform pursued a different agenda, independent of Bologna. The low priority of the Process also translated into a lack of ownership and leadership by HE authorities and the political option of non-interference (Vedung, 1998).

Denmark could pride itself on a solid and successful HE system manifest in a high quality and high research output (Oddershede, 2010, p. 1; OECD, 2004, p. 21). However, as a small country, Denmark values international collaboration (Danish Rectors' Conference, 2002, p. 18) and is keen to grasp its benefits. Bologna thus emerged as an opportunity to internationalise its higher education, namely to ensure the recognition and appeal of its degrees and thus attract international students while at the same time promoting outward mobility. A desire of alignment driven by recognition and increased mobility are thus the motivations behind engagement. This materialised in a series of legislative and regulative measures meant to set off the implementation of the three-cycle system, ECTS, Diploma Supplement, an accreditation agency etc. In addition, the Government's globalisation strategy was the driver behind other comprehensive higher education reforms. It appears, however, that Bologna was not interpreted flexibly as in other countries, as there is no evidence of the initiative being used as a justification for reforms running in parallel with the implementation of the Bologna aims. These parallel reforms were aimed, for instance, at addressing poor completion rates and long time to graduation and at changing the governance regime of HEIs. The significance attributed to Bologna nationally is demonstrated by the passing of legislation – regulation as ‘sticks’ (Vedung, 1998) – to enforce compliance and trigger its implementation.

Portugal used Bologna as an opportunity to modernise its HE system. Traditional long degrees were a hindrance for HE participation and completion; thus the shortening of studies and separation into cycles appeared as means of widening access as well as of providing flexible routes into higher education. Moreover, Portugal was keen to ensure the compatibility of its degrees with European ones to facilitate recognition and the mobility of its student population (expectations of comparability with European degrees are set out in Decree Law 74/2006). As in the case of Denmark, being a small country but in addition with a self-perception of disadvantage versus the rest of Europe makes Portugal keen to align to European trends perceived as modernising. Bologna and addressing Portugal’s delay in the implementation of its recommendations thus became a first priority for the Ministry of Science, Technology and Higher Education in 2005, according to a declaration by the minister. Legislation abounded and made compulsory the implementation of Bologna reforms in the areas of degree structure, recognition tools and quality assurance. However, a wider range of reforms have been prompted by an OECD review, although these sometimes appear to be assigned to Bologna in the sector.

At institutional level in physics departments, reception and views about Bologna display differences both in relation to the national reception and between the views of academics in the three countries. In all three national academic constituencies, Bologna is equated with the 3+2 structure, but beyond that there are variations in what Bologna means for them, illustrating Ball’s ‘policy as text’ metaphor (Ball, 1994). Attitudes to Bologna vary: English academics feel it has no bearing on their work and, despite appearing favourable to it, they feel disempowered by the lack of funding and leadership; Danish academics are indifferent and sceptical about the reorganisation of studies; Portuguese academics, while critical of the reduction of study years, view Bologna as embodying a new teaching paradigm.

In England the interviewed academics perceive Bologna as a European-wide structural reform aiming at degree comparability. Mobility appears in their discourses to a small extent. It is the 3+2 structure that is associated with Bologna, and with some exceptions opinions are generally favourable towards it. However, there is criticism of the British government’s conflicting actions which on the one hand signed the Bologna Agreement, but on the other hand fails to provide adequate financial resources for postgraduate education to allow the British master's alignment to the European model. It is worth noting the decoding of Bologna as requiring compliance and the belief that the 3+2 structure is a Bologna element. What appears remarkable in the case of English academics is the remoteness of the Bologna Process from their academic business. Even though perceived as a policy requiring some kind of compliance, it is not something that impinges on individual academics. It is within the remit of teaching committees and the like to ensure appropriate action is taken and then to communicate further down what needs to be done. However, this decision-making layer feels unsupported and resents the lack of initiative at national level.

Danish academics also understand Bologna as a European initiative envisaging greater degree comparability. Mobility is identified this time as the ultimate aim. Bologna is again associated with the 3+2 organisation of studies and in one institution with ECTS. The reactions it awakens are a mixture of indifference and scepticism. Indifference is explained by a similar organisation of pre-Bologna degrees, the 3+2 model having existed already since 1993. This led to a relatively easy adaptation of degrees. Scepticism is explained by disapproval with the worth and relevance of the bachelor in Danish academia, society and economy, therefore implemented begrudgingly. It appears that overall Bologna failed to generate much debate among Danish academics, contradicting national actors' rather optimistic view about Bologna's reception in universities. Moreover, confusion seems to permeate academia over the source of other reforms, whether Bologna-related or not.

In Portugal, academics understand Bologna as the new degree structure aligned to the European model and are generally critical of a perceived degree devaluation. A remarkable aspect to note is the reinvention of Bologna as a new pedagogic paradigm by Portuguese academics. This was not a dimension initially envisaged by official documents, either European or Portuguese. Bologna is reinterpreted as an opportunity to embrace a student-centred education transforming students into independent learners, allowing greater curriculum flexibility and having a bearing on teaching practices. Bologna appears to have enjoyed a favourable reception in the universities in this research and has been grasped as an opportunity to improve study programmes – it has thus affected teaching and learning regimes (Trowler & Cooper, 2002) contrary to the situation in the other two countries. Besides adding this unexpected dimension to the Bologna Process, universities appear to have taken the lead in the reorganisation of degrees before legislation meant to set this very process in motion was passed. This self-appropriation of the Bologna Process appears as a consequence of fears of lagging behind compared to European universities and frustration at government inaction. In any case, universities have been ahead of the game both in the implementation of Bologna and in anticipating a new dimension.

To sum up, three different pictures of implementation emerge. In *England* the *national level* expects bottom-up implementation to occur on account of the much valued institutional autonomy; few Bologna-related initiatives appear to happen beyond debates in European fora and the creation of a national agency to act as lobby and source of information. However, *institutions* feel ill-equipped and expect coordination and leadership from national bodies. They engage with the Bologna Process through scattered initiatives, such as the creation of a two-year EuroMasters in one institution and the adoption of ECTS in the other. Their range of action feels constrained by the funding regime. Thus, there are pockets of initiatives on the ground, but top guidance would be welcome – hence an attitude of selective acquiescence. In an odd way, agency needs structure (Trowler, 2002) to feel supported and be able to act.

In *Denmark national authorities* pass legislation to set in motion the implementation of Bologna seen as an internationalisation opportunity. The level of detail in legislative texts is impressive. *Universities* seem to comply, albeit uncommitted and disapproving of the bachelor. Little debate surrounds the issue. The Danish case appears as a case of top-down implementation and strategic conformity.

In *Portugal* Bologna-driven initiatives take place both at grass-roots and political level in an effort to modernise the HE system. At *national level*, legislation abounded to pave the way for the implementation of Bologna. Apparently, however, *institutions* frustrated with waiting took the initiative and started implementing the Bologna recommendations prior to legislation in a context of institutional autonomy granted by the 1988 University Autonomy Act. They also invested Bologna with a new pedagogic dimension which official documents then legitimised. Portugal therefore illustrates a case of bottom-up engagement and creative commitment to Bologna.

Chapter 9 The ontology of the master – conceptualisations

The previous chapter considered the three countries' response to Bologna. I now move on to the master degree as the second cycle in the Bologna-advocated cycle system, whose conceptualisations and manifestations are expected to have been influenced by the Bologna Process. Therefore, consistent with the assumption of situated meanings and actions, the next two chapters look at national and institutional conceptions and practical implementation of the master as mixed outcomes of the influence of Bologna and of previous degree traditions.

Earlier I talked about the conceptualisation of master degrees as representations of educational knowledge which conceive of, articulate, transfer and evaluate knowledge in particular ways. National and institutional settings as well as historical linkages determine how these processes take place – hence the possibility of describing degrees as situated representations of knowledge. The nature and delivery of degrees are determined not only by the knowledge dimension of the discipline and the qualification level, abstractly speaking what a master is, i.e. the *ontology* of physics masters, but also by the processes and practices employed in the different settings, i.e. the *enactment* of the knowledge dimension. I therefore propose the concept of *enacted ontology* to describe master degrees to take account both of epistemological features and of social and academic practices.

This chapter addresses conceptualisations (ontology) of master degrees in the three national and six institutional settings considered in this research. It pays particular attention to changes in understandings triggered by Bologna. The next chapter will then turn to practices (enacted ontology).

High level national guidance prescribes conditions a master degree should fulfil regarding structure, purpose, student competences, the weight of research etc. However, the interpretation of these objective descriptors is coloured by institutional and disciplinary factors, as this research has illustrated. Student experience, too, is sometimes convergent and sometimes divergent from academic accounts. The (mis)match between the official status of degrees and their understanding by physics academics and students is addressed next. The differences between the three countries are also highlighted. The same categories which have ordered the analysis are discussed: structural aspects, bachelor-master relationship, purpose, student competences, research dimension.

Structurally, according to national regulations the master[16] is a distinct qualification level usually assigned 90 ECTS[17] in England (one calendar year), 90-120 in Portugal (three to four semesters) and 120 in Denmark (two academic years). In Portugal and Denmark credit ranges and length are stipulated in national qualification frameworks and legislation passed further to the implementation of Bologna, whereas in England the FQ-EWNI and the credit framework recommendations indicate credit ranges. However, the formal existence of the master as a distinctive qualification in official texts does not always correspond to perceptions and practices in academia and society. Differences exist, too, in the understandings of the master degree's purpose – I propose the following typology: educational exchange (further studies orientation) and instrumental (job market/employment orientation).

In *England* the master degree enjoys a clear identity. The boundary between the bachelor and the master is well-defined, the latter appearing as a real second-cycle qualification. The bachelor is the typical exit degree, whereas the master is a qualification that adds value to students' curriculum, giving them a competitive advantage. Nonetheless, some of the physics academics interviewed consider that for a professional physics career the master is the legitimising degree, the fundamental level of training needed to compensate for the shortfall in basic knowledge acquired during the bachelor. This is most likely a consequence of the epistemological nature of physics as a vast, cumulative knowledge area requiring long periods of maturation, as shown in Chapter 4.2.2. Thus, although a second-cycle qualification, it is also essential training for the profession. Students confirm this view. They believe that the master is essential training for a professional physicist; in turn, a physics career is associated with research. They go even further and present the PhD as the pre-requisite for a research career.

Although Bologna has not triggered any changes in the English degree framework (considered the reference for the Bologna model), it has caused concerns about the compatibility of the English master on account of its duration. This appears to be

[16] The academic, stand-alone master is discussed (as opposed to professional and integrated masters), as the Physics MSc falls into this category.

[17] 90 ECTS are justified by the fact that the master runs over a full 12-month year, the thesis usually being developed over 3-4 months in the summer.

particularly the case in STEM areas because of their strong classification (Bernstein, 1971) and their hierarchical knowledge structure (Donald, 1983), requiring a solid and vast body of fundamental knowledge as opposed to soft areas (Becher & Trowler, 2001). As a result, there are two perceptions sitting uncomfortably side by side: according to the traditional function of the English master, it is a qualification fit-for-purpose; according to the European norm, length becomes problematic and casts the master in a negative light, as a lacking qualification, threatening the competitiveness of the English degree and its graduates. Interviewees speak of anecdotal evidence of English master students treated as unqualified to enter European PhD programmes. Moreover, the Institute of Physics representative refers to more robust evidence that over the last decade the majority of appointments to UK physics academic and post-doctoral positions have been people who did not pass through the UK system. At the same time, there has not been a corresponding flow of people out of the UK. A risk thus emerges that English students might not be seen as equivalent to their continental counterparts.

The way forward might be two different degrees targeted at different student populations: the current one-year degree for British students and, probably, overseas students, and a two-year degree for European students or students with a European projection. This is already happening in one institution in this research which offers a two-year EuroMasters in Physics. However, there is concern in the academic constituency about the funding of the additional year in the absence of HEFCE support (see section 5.2.2) and the expectation that students should fund their education themselves. Self-financing appears highly problematic, with fee levels in England unequalled in any European country.

Besides reputation, the disadvantages of the shorter master are, in the academics' view, the breadth of knowledge, the extent of research and independence experienced by students and the difficulty of making an informed choice on the next career step. Students speak of similar shortcomings: a rushed and intense degree; lack of time for reflection and in-depth understanding; no leeway to make mistakes in the thesis; difficulty to decide whether their next step should be a PhD, not having yet experienced research and potential areas at the time of the applications.

National actors' view is that the instrumental master is prevalent in England: the majority of master students are mature and in employment, the degree being an opportunity for career progression and professional development. It is thus linked to lifelong learning. However, in physics the educational exchange value appears to weigh heavier both for academics and students. The majority see the master as a stepping stone to a PhD, which in turn will lead to a research career.

In *Portugal* the alignment of degrees to Bologna resulted in a perceived ‘depreciation’ of traditional degrees, a perception anchored in the pre-Bologna system. The choice of qualification names which previously designated longer degrees is criticised as misleading. The master is perceived as devalued in relation to the former master, rather the equivalent of the previous licenciatura. It is the degree that enjoys recognition and popularity and seems to have replaced the former licenciatura as the fundamental level of training. This perception is shared at national and institutional level.

National actors acknowledge the lack of understanding of the new degrees in academia and society and the weight of preconceptions in perceptions. The message that new degrees are different from old degrees struggles to get through. Academics portray the master as a hybrid qualification between the former licenciatura and the former master created by adjusting the two. They often speak of the master as the 4^{th} and 5^{th} years, an association with the previous licenciatura. The degree generates mixed feelings. On the one hand, academics speak of negative consequences following the reduction of years: lower level of student knowledge on entry, requiring lower level of courses; a reduced scope of the thesis; and lower expectations of student achievement. On the other hand, the earlier start on a distinctive upper qualification gives an opportunity for higher demand and higher expectations sooner and allows earlier contact with research and knowledge application. The hybrid nature of the new Bologna master is also evident in the students’ experience: they describe the master as a continuation of the first cycle (the first year being identical, but harder) and as the 4^{th} and 5^{th} years of education. They also complain of the reduced place of research in the new master compared to the previous one and the shift from a research to a taught degree.

Concerning the master’s purpose, according to legislation the university master envisages academic specialisation and research. However, the Bologna master is perceived as a vague qualification with blurred identity and purposes, with both instrumental and educational exchange values, as opposed to the clear research orientation of the previous master. The political vision for the master is that of a key qualification allowing continuous retraining in a lifelong learning strategy. Among the interviewed academics and students, the educational exchange value is more pronounced, further studies emerging as the common next step. When instrumental, the master still appears as preparation for physics research careers.

In *Denmark*, the passing of legislation to establish Bologna degrees has had little effect on people's conceptualisations of the master degree. Despite the prior existence of a 3+2 structure, the master (candidatus) was the qualification envisaged by students and academics, the bachelor existing only on paper. In perceptions, the master was equivalent to a five-year education, the two tiers having no distinctiveness. This is still largely the case at present. The master continues to be the default degree, still generally understood as five years rather than an upper two-year cycle building on the bachelor. A lack of individuality of the master as a second cycle qualification is confounded by the bachelor's lack of identity. Academics perceive the bachelor as an artificial degree inserted into the five-year long candidatus, an externally imposed sub-component of little value on its own. There is a tacit assumption among academics and students that these will graduate with a master. However, increased mobility between cycles is starting to shift perceptions, with institutions having to establish self-standing programmes relevant to students coming to do the master from other universities.

Since the master has traditionally been (and continues to be) the default HE qualification, it has equally instrumental and educational exchange purposes. Legislation stipulates the dual purpose of the academic master as a door both to further studies and professional employment. This dual purpose is also acknowledged by the academics and students interviewed in this research, with students being able to tailor their programme to suit their career choice.

The effects of the Bologna Process on the degree framework and the nature and understanding of the master degree display, therefore, variation in the three countries in this research. In England, Bologna failed to have an effect on the organisation and structure of HE degrees. The master has been and is a genuine second-cycle qualification. However, especially in academic circles in STEM areas, the European shift towards a two-year duration has provoked anxiety and concerns about the English master's compatibility and recognition. Simultaneously, it appears fully legitimate in an English context. Most students graduate with a bachelor, the master being a bonus degree and a lifelong learning tool. It has both instrumental and educational exchange purposes, but in the case of physics the latter is far more pronounced. In Portugal, Bologna has led to a major restructuring of the degree framework (reduction of study years and three degrees instead of four) and the creation of the master as a second-cycle qualification. In practice its implementation has translated into an adjustment between the previous licenciatura and the previous master. It has replaced the licenciatura as the fundamental level of training and most students pursue a master. Although perceived as a separate second-cycle qualification, it is held to deliver basic training topping up the licenciatura. The political vision of the master linked to lifelong learning is yet to be realised. It has blurred identity and purposes, both instrumental and educational exchange ones, compared to the clear research focus of the former master. In Denmark, hardly any change has been noted in the transition from the pre- to the post-Bologna master. The master is still viewed as an integrated five-year rather than a separate two-year education despite legislation to establish it. However, as the bachelor might gradually gain acceptance and mobility increases, the Bologna master as a genuine second-cycle qualification might emerge more clearly. At present it continues to be the default university education for the large majority of students. It was and continues to be a qualification with instrumental and educational exchange values. As regards lifelong learning, it is the professional master that aims to deliver professional up-skilling and re-training.

As to student competences, differences between official descriptions in qualification frameworks and the academic perception are worth highlighting. Advanced knowledge, mastery of methodologies and means of enquiry, critical understanding, independence and initiative – present in frameworks – are also mentioned by academics and students. The emphasis on research skills in the case of English and Portuguese academics is worth noting, as opposed to a lower emphasis in Denmark. We can speculate whether this is due to research skills being implicit and taken-for-granted in Danish university education (also described as research-based in legislation). The major difference is the focus on communication skills in national frameworks and its feeble presence in academic and student accounts. This reinforces the findings presented in the Chapter 4 according to which physics is a discipline preoccupied with cognitive concerns rather than soft skills. Only students in the Danish universities and a Portuguese one think the degree fosters the development of communication skills. It is remarkable that in both these institutions initiation to research emerges as holistic, going beyond the thesis in an organic way, through project-based learning and research tasks. Thus the development of soft skills, a weakness in physics, appears facilitated by students' exposure to tasks and activities typical of a research environment.

Davies (2009) found research to be an uncontested feature of the master in Europe. The degree's research dimension has thus been an analytical concern. All qualification frameworks identify research skills as a student competence. National regulations all make reference to the research project, in all cases representing at least a third of the degree. This amounts to at least a semester and a half in Denmark and Portugal and the summer period in England.

In Denmark the research project is highlighted by the Ministry representative as the only curricular component regulated through legislation, signalling its importance. Research also distinguishes the academic master from the one-year professional master. In England, the taught master (the category the MSc falls in) aims to teach students research skills, as opposed to the MPhil whose objective is the development of a research project. In the MSc research does not appear as an end in itself, but a means to equip students with skills useful in their future career. Academic and student views also reveal the primacy of research skills over the scientific outcome. Nonetheless, some students would favour a longer project allowing thorough application of their research skills or resulting in useful research outputs. However, it is in preparing qualified PhD students that the short master is perceived as lacking in one institution. In Portugal the new Bologna master is perceived as more research-light than the previous master, most likely a consequence of the degree's massification. However, all academics place strong emphasis on research skills development during the master.

In all the six degrees here research materialises in the project, integration in research groups and research-informed teaching. Besides, one English university offers tailored research training through specific courses, and in one Danish and one Portuguese university research training occurs holistically (as above) by constantly exposing students to research practices.

With the exception of one Danish institution, students view research as the hallmark of master education, in most cases through engagement with the research project. The master is experienced as initiation to a physics research profession and a first stage in apprenticeship. This chimes with previous findings presented in Chapter 4 on the strong research focus in physics and the tight organisation of research manifest in the existence of research groups and the interdependence between staff and students.

Integrating the findings about master degree perceptions pre- and post-Bologna, its purpose and research dimension, one possible interpretation could be that it is primarily the weight and function of research that makes the difference as regards degree length. In England the presence of research in the MSc envisages the development of research skills, the scientific output being of secondary importance. This goes towards explaining the degree's shorter duration. In opposition, the research project in the Danish master (candidatus) is attributed paramount significance (45-60 ECTS), the research element distinguishing the academic master from the one-year professional master (a professional development qualification). In Portugal the post-Bologna master is deemed to have lost its research orientation and to have become a taught degree following massification and lower student preparation on entry. Even so, the research project is dedicated around 45 ECTS. Another indicator of the relationship between research and duration is the research-related nature of the identified shortcomings of a shorter master in England. Moreover, it is the qualification's ability to prepare students for a research degree (PhD) that raises question marks, rather than its ability to equip them for the job market. This most probably links in with physics being a research-heavy discipline and research a quality essential for success in a physics career. Another criticism of shorter degrees addresses the impossibility of covering all fundamental physics knowledge in a limited time-span given the epistemological nature of physics as a vast knowledge area. These points explain, at least partially, why it is mainly STEM subjects that have expressed uneasiness at the emergence of the two-year pattern for the Bologna master.

Chapter 10 Master degrees as enacted ontology – learning and teaching practices

The previous chapter looked at conceptions of master degrees regarding structure, their relationship with the bachelor, purpose, student competences and the role of research. The transposition of these conceptions of what a master is (*ontology*) into real master programmes (*enactment*) is coloured by national, institutional and disciplinary factors, as this research has illustrated. Institutions, departments and academics display different understandings and practices which leave their imprint on the master degrees considered here. Students, in turn, describe their experiences in ways which sometimes converge with and sometimes diverge from academic accounts.

This chapter addresses learning and teaching practices as *enacted ontology* in the three national and six institutional settings considered in this research, drawing attention to changes triggered by Bologna.

Learning and teaching practices bear the mark of national and institutional traditions. The durability of encultured knowledge (Blackler, 1995) and implicit theories of learning and teaching (Trowler and Cooper, 2002) become evident in the extent of adoption and embedding of new tools and practices, such as learning outcomes in Portugal, ECTS in England, or the prevalence of the oral exam in the Danish degrees considered here. Whereas these might be culturally determined phenomena, the institutional context exerts an influence, too, as evident in differences in core teaching, learning and assessment practices between institutions in the same country. Besides national and institutional factors, epistemological disciplinary aspects also play a role, for instance in the widespread acknowledgement of the centrality of problem-solving and research skills in physics. The differences and similarities in learning and teaching in the master degrees covered by this research will be presented next with consideration to the following dimensions: course composition, learning outcomes, ECTS, learning, teaching and assessment practices. Bologna effects on practices will also be highlighted.

COURSE COMPOSITION. The loose degree composition in England and Denmark stands out against the tight structure in Portugal. Differences in rules of appropriateness (Trowler and Cooper, 2002) regarding student input into course design become evident in practice. Thus, all physics courses in the English degrees are electives, and one institution offers compulsory courses in enabling skills (e.g. research, transferable, mathematical). The Danish degrees also favour student choice, with no compulsory courses in one institution and only three compulsory ones in the other one. The importance of a flexible curriculum and student choice is, in fact, signalled in Danish legislation. Thus both in England and in Denmark there is confidence in students' ability to choose appropriate courses and they are granted control over the design of their learning. In contrast, the two Portuguese degrees comprise a large proportion of obligatory courses: half and respectively almost two thirds – an improvement, nonetheless, on the previous rigid degrees which allowed no student choice. Bologna has thus brought about increased curriculum flexibility and student control. Compliance with Bologna is, in fact, highlighted by both Portuguese degrees. The comparability concern is obvious in legislation, too, requiring courses to demonstrate compatibility with renowned European courses. However, the degree of student freedom is a major difference between the degrees considered in this study. We note weak framing in the English and Danish degrees and strong framing (Bernstein, 1971) in the Portuguese ones from the point of view of transmitted knowledge.

Students have mixed opinions about their freedom. Generally in all three countries student choice is in principle welcome. Nevertheless, the small number of students enrolled in the Portuguese degrees and logistical problems (e.g. timetable overlaps) make student choice rather unfeasible in practice. One surprising student attitude was criticism towards student freedom because of students' alleged inexperience and knowledge to ensure they make the right choice. Danish students, too, are sometimes critical of lack of relevance, overlaps in courses, and in one institution of limited course choice beyond physics.

Therefore, no uniform curriculum has been observed in the degrees considered in this analysis despite the strong classification characteristic of physics (Bernstein, 1971). This is consistent with findings of recent surveys (Kehm & Alesi, 2010; Kehm & Eckhardt, 2009) indicating that similarity among bachelor level curricula is not replicated at master level – probably illustrative of the preoccupation with advanced specialised knowledge, identified as one of the key markers of master degrees both by academics and students in this study.

LEARNING OUTCOMES. Use of learning outcomes is a new Bologna-triggered practice adopted by the Danish and Portuguese degrees, whereas no change has been noted in the English degrees which already employed learning outcomes. England stresses its concern with educational output – expressed in learning outcomes – and national level actors describe English HEIs as advanced in their understanding and usage. Academic accounts and practices confirm this is the case. Learning outcomes, recognised as student-centred pedagogic tools, are thoroughly defined in programme and course specifications. However, student awareness of them is not widespread. In one institution some students recognise them as knowledge, abilities and skills, but they are not always deemed useful. In the other institution, despite teacher confidence that students are aware of learning outcomes, students make reference to content and topics.

Both in Portugal and Denmark national regulations required the rewriting of course and programme specifications to include learning outcomes. The understanding, assimilation and embedding of this practice in institutions are, nonetheless, variable. Interviewed Danish academics are unanimously aware of learning outcomes and their function as pedagogic tools. The educational thinking behind learning outcomes was already present in Denmark in the 1990s, which has probably facilitated their understanding and inclusion in course and programme specifications. However, opinions about their usefulness vary. Some academics recognise them as helpful in course design and assessment, whereas others criticise them as restrictive and little useful for students. In Portugal the understanding and embedding of learning outcomes lag behind. This is both acknowledged by national level actors and reflected in institutional practices. On paper, one institution appears to make appropriate use of learning outcomes. However, in reality the exercise of setting learning outcomes appears to have been purely bureaucratic in both institutions, since interviews suggest little awareness of the concept, let alone embedded practice. It is still content that appears to drive teaching practices.

This is corroborated by student perceptions. Although awareness of learning outcomes as student achievement is almost unanimous among Danish students, opinions about their relevance are split, some students confessing not paying attention to them. Among Portuguese students, awareness is entirely absent.

The above discussion suggests that learning outcomes, when employed conscientiously, are above all useful tools for teachers to inform curriculum design and teaching and assessment practices. However, so far learning outcomes appear less meaningful for students.

Learning outcomes also illustrate the relationship between tacit assumptions and implicit theories of learning and teaching (Trowler & Cooper, 2002) on the one hand and practices on the other hand, as well as the primacy of the former over the latter. Thus in England there is consistency between theory and practice and they have been coexisting in harmony. In Denmark, although the practice is new, it appeared relatively easy to implement and embed, having found correspondence in a student-centred pedagogic mindset. In Portugal, where pedagogic assumptions have been teacher-centred, the implementation of a student-centred pedagogic practice has been superficial and so far cosmetic.

ECTS. Perceptions and usage of ECTS tell different stories in the three countries, too. There is, however, shared scepticism about its reliability and accuracy. All degrees in this study attribute equal ECTS values to courses and workload is subsequently adjusted.

In England national actors express concern at ECTS being a measure of time (threatening recognition of British degrees) and advocate linking credits to learning outcomes. Institutional autonomy grants HEIs freedom to decide on the choice of credit system, and one of the two HEIs in this study moved to ECTS. Interviewed academics are sceptical about its reliability, saying that British students work fewer hours than indicated by ECTS values, comparing them with exchange students accustomed to higher workloads. Students show little familiarity with, or interest in, credits.

Portugal and Denmark have made ECTS compulsory in the wake of Bologna. However, in both countries opinions are split about the appropriateness of its implementation and usage, scepticism emerging around ECTS accuracy. A notable aspect for both sets of Danish academics is the confidence in the precision of the system in their own departments, but mistrust in its use in other institutions and countries. Another perceived shortcoming of ECTS in both countries is failure to indicate the level and standard of a course. In Portugal, the detailed information on the distribution of ECTS among teaching and learning activities (lectures, seminars etc) is remarkable. Quantifying study time appears to have raised awareness about the time students dedicate to private study and has led to a reduction in contact hours. This is not universally seen as beneficial for student learning – an indication of the conflict between traditional implicit theories of learning and teaching and a new 'recurrent practice' (Trowler and Cooper, 2002) evident in reduced teacher input.

Both the Danish and Portuguese degrees seek student feedback to ensure correspondence between student effort and ECTS allocations. Nonetheless, Portuguese students generally believe ECTS fails to reflect their real workload, whereas in Denmark opinions are split. In one institution, they agree that different courses require similar effort, but they question the consistency of ECTS allocations across institutions.

ECTS thus enjoys little confidence as a measure of time spent studying – mistrust in its reliability and the consistency of its usage is the dominant attitude.

So far, I have addressed dimensions adjacent to the core teaching process, informing and supporting it. I now turn my attention to teaching, learning and assessment practices, the core of the teacher-student exchange.

TEACHING. National level guidance on teaching and learning, although limited, is somewhat indicative of specific country preoccupations and pedagogic approaches. In England the link between learning outcomes and teaching design stands out (QAA, 2010), while interviews highlight student-driven learning. In Portugal official texts make repeated reference to the change of pedagogic paradigm and measures to achieve it, while interviews document change in progress and confusion around the concept of student-centred education. In Denmark there is a focus on improved pedagogy to address completion times and on curricula mindful of student employability, while interviews highlight student independence and project-based teaching.

At institutional level, core teaching activities are surprisingly similar across the six degrees included in this study. Lectures (expository) and problem-solving classes (interactive) emerge as central to the teaching of physics-specific courses both in academic and student accounts. Problem-solving classes in particular are probably explained by the centre stage this practice occupies in physics. Beyond these core teaching components there are some variations among degrees, for instance the enabling courses (research, mathematical skills etc) in one English institution, or the presence of project work and research-specific tasks (not thesis-related) in one

Danish and one Portuguese degree. In the case of the Portuguese programmes, the difference in student perceptions is remarkable: students describe teacher-centred approaches in one institution and student-centred approaches in the second one. Nonetheless, teachers in both institutions speak about the introduction of new teaching practices in their teaching repertoire further to Bologna.

Transferable skills are usually addressed indirectly, with just one English and one Danish degree having courses specifically tailored to develop transferable skills. Otherwise, these (mainly interpersonal and communication skills) are cultivated through interaction within research groups during the thesis in an apprenticeship-type manner, or through student presentations throughout the degree. Student satisfaction with opportunities to develop soft skills is variable and the only consistent pattern noted is the relationship between project- and research-based teaching and learning and higher satisfaction with soft skills development. In Denmark, the predominance of oral exams facilitates training in presentation skills, too. Some students emphasise the primacy of physics skills and knowledge over soft skills, signalling the dominance of cognitive concerns in physics.

LEARNING. Student learning activities generally revolve around problem-solving and reading to complement lecture material. Differences emerge in the extent of received guidance and the type of literature. Student and teacher accounts suggest that in the English and Portuguese degrees reading is loosely directed: teachers indicate a list of recommended literature and students have to search for additional information themselves, lecture topics usually being left open-ended. English students have varied opinions about the need for further reading, some saying that lecture notes can be enough to fare well in the exam. In contrast, in the Danish degrees reading appears to be mainly guided, based on textbooks, and happens in advance of lectures. As to the presence of research literature in student reading, it seems to apply mainly during the thesis. Only students in one Portuguese and one Danish degree mention that research literature can form part of their readings not related to the thesis. The same degrees are the ones in which students describe learning as happening through project and research-related tasks, portraying it as initiation to a professional physics career. Although problem-solving is mentioned unanimously, it seems to receive lower emphasis in the Portuguese students’ accounts and significant weight in the case of one Danish degree.

Teaching and learning approaches generally suggest the dominance of propositional knowledge in the taught part of the analysed physics degrees. In addition, the development of the thesis lays emphasis on deliberative processes, students having to plan, approach problems, make decisions etc. (Eraut, 1994). However, the programmes where learning is informed by research practices throughout already assign importance to deliberative processes in the taught component of the programme.

ASSESSMENT. Whereas teaching and learning share more similarities than differences, assessment practices display sometimes national and sometimes institutional particularities. Disciplinary factors do not appear to influence significantly assessment forms. Denmark is the only country where the two degrees employ similar assessment methods. National tradition is evident in the predominance of the oral exam as the standard assessment method. Both degrees rely on summative assessment, but continuous assessment is gradually gaining ground out of concern with completion times. One institution also employs evaluation of project-based assignments and papers. On the contrary, in the English and Portuguese HEIs it is the departmental teaching and learning regimes that determine practices, national influences being less visible. The Portuguese programmes appear very different from each other, and so do the English ones. In England, in Institution 1 summative assessment in the form of unseen written exams is the prevalent practice (although other methods are employed too), whereas continuous assessment and a variety of methods are the norm in Institution 2. In Portugal Institution 1 relies on summative assessment and final written exams, although other methods are gradually making inroads. In contrast, Institution 2 employs predominantly continuous assessment and a range of methods (although the written exam continues to be the most common one). Moreover, students speak of a transition to research-informed assessment in year two.

The prevalence of summative assessment in four out of the six degrees in this study verifies findings highlighted in Chapter 4 about assessment in physics. The gradual incorporation of continuous assessment also resonates with the findings of recent surveys (Kehm & Alesi, 2010; Kehm & Eckhardt, 2009) undertaken in the wake of the Bologna Process. However, only in Portugal is growth in continuous assessment attributed to Bologna.

Academics and students unanimously agree that assessment aims to test understanding of physical laws and principles as well as physical intuition and reasoning. To this aim, factual knowledge is a necessary tool, a means to an end, but not an end in itself. Students must be able to draw on knowledge to solve problems and apply it to new situations which require a broad overview and higher level understanding of concepts, laws and interconnections. Replication, therefore, is not a mode of knowledge use favoured in the physics MSc programmes in this study. Application and interpretation are the dominant modes of knowledge use (Eraut, 1985).

Problem-solving skills are an equally important concern in assessment. In fact, ‘skills’ were often understood as problem-solving by academics. As to transferable skills, opinions emerge around the difficulty to assess these in physics and their shadowing by the primacy of scientific, cognitive content. It is thus embrained knowledge as opposed to embodied knowledge (Blackler, 1995) that appears paramount in physics. Despite the recognised value of skills deemed useful in a research career and environment (presentation, communication, interpersonal skills, team-work etc), these do not seem to be given much consideration in assessment, although they can influence it. Again, the low emphasis on transferable skills resonates with other research findings presented in Chapter 4.

To summarise on the influence of Bologna as a pedagogic driver, English academics do not identify any changes in their practices. The one change attributed to Bologna is ECTS adoption in one institution. On the contrary, Portuguese academics report significant changes in their practices in all dimensions considered in this study – all illustrative of a shift towards student-centred education. Some have been deeper than others. For instance the implementation of learning outcomes seems to have been superficial, undertaken as a bureaucratic exercise, neither conceptually internalised, nor embedded in practice. This contrasts with the situation in Danish and English programmes where use of learning outcomes emerges as an embedded recurrent practice. Course composition shows increased flexibility and students have more input into the design of their learning, at least on paper if not in reality due to practical constraints. ECTS, also introduced further to Bologna, appears to be employed conscientiously and has drawn attention to the time students dedicate to individual study. Teachers also report the inclusion of new teaching and assessment methods in their repertoire, attributing them to Bologna and the transformation of pedagogic paradigm. In Denmark, changes have occurred in pedagogic practices in the last decade, but only some appear Bologna-related, for instance the implementation of ECTS and learning outcomes regulated nationally in the wake of Bologna. Although academics also speak of increased attention to student learning and changes in their teaching practices, they attribute these to recent nationwide concerns with completion times and earlier student entry and graduation.

Chapter 11 Conclusion and synthesis

The last three chapters have offered a detailed comparative analysis of the reception and understanding of the Bologna Process in England, Portugal and Denmark; the conceptions of the master degree relative to a number of dimensions among national actors, academics and students; and the teaching and learning aspects reflected in academic practices and student experiences. The research has focused on physics as a case in point to demonstrate the continuities and differences in the enacted ontology of master courses across three contrasting national contexts in response to the Bologna Process. While the research refers to this specific degree, especially as regards the institutional level represented by teachers and students, my conclusions have resonance for policy and practice across the whole higher education curriculum. This is enhanced by the interviews with European and national actors which focused on master programmes in general.

I argued for the choice of physics in Chapter 4. One reason which weighed considerably was the strong 'classification' of physics (sense of disciplinary identity, boundary and continuity) and the degree of consensus around the discipline's concerns, methodologies and knowledge verification procedures. Consequently, an implicit expectation in a highly bounded discipline is of a large degree of similarity among degrees. Conversely, as I note in Chapter 4, disciplines which have low classification are likely to have high levels of situated identity and variance. Despite these considerations, a consistent theme, evident throughout the analysis of the physics masters and in the account presented next, is the variation observed in a number of pedagogic practices.

This thesis thus suggests that despite factors which are expected to facilitate degree convergence, disciplinary on the one hand and political (i.e. Bologna-triggered reforms targeting degree comparability) on the other hand, variation continues to be a feature of physics MSc degrees explained by contextual (national and institutional) ontologies, circumstances, interests and constraints.

Drawing on insights from this analysis, I now address the three research questions which have guided this study.

1. What conceptions do stakeholders at the different levels on the Bologna policy implementation staircase (European, national, institutional) hold of the master and how do these shape the degree's implementation?

This research suggests that master degree conceptions – designated as ontology – are determined both by national HE traditions and by the location of actors on the implementation staircase. Especially country-specific traditions appear extremely powerful in shaping the degree's conceptualisation and implementation in the three countries. Variations in conceptualisation between implementation levels have been observed, too: the European and national levels discuss the master in general, whereas institutional actors focus on physics. In the latter case the capacity for articulation is more dense and precise, since ontology is grounded in practice and experience.

Historical traditions of university degree organisation explain to a great extent actors' conceptions of the master in general. In some cases, its enactment remains quite faithful to tradition, although traditional understandings appear inevitably challenged by the Bologna Process. Such is the case of Denmark, where implementation of the master has not required great changes, but it has challenged people to think of the degree as a separate cycle rather than a five-year education. Such is also the case of England where the master has stayed the same, but comparability and recognition concerns have raised questions about its continued viability. In contrast, in the case of Portugal drivers stronger than tradition (modernisation and recognition) intervene to trigger significant changes. Nonetheless, despite implementation of the new master, conceptions based on traditional degrees remain strong and actors find it difficult to understand the new degrees. In all cases, inertia and the durability of tradition are obvious, manifest either in implementation decisions or in ontologies.

In England, the master has traditionally been understood as a second cycle qualification with primarily instrumental purposes, a complement to the first cycle aimed to act as a professional development or re-training opportunity. However, physics academics and students emphasise more its educational exchange value leading to PhD education. The explanation probably lies in the pronounced research orientation in physics and the association between a physics career and research. The emergence across Europe of predominantly two-year masters has also raised concerns principally in hard convergent disciplines such as physics, where degree similarity is expected more than in soft areas on account of the discipline's universal nature. The one-year English master, fit for purpose in a home context, now appears to feel its reputation threatened when compared to longer programmes. Hence the creation of two-year degrees such as the Euromasters, branded as Bologna-compatible, targeted at European students, reflecting the apparent discontinuity between the national conceptualisation of the master degree in general and the conception among the physics constituency.

In Denmark, again, tradition steers conceptions and implementation of the Bologna-based degree framework. Although the necessary changes were minor (an official, if not real, 3+2 structure already existed) they have been criticised as superficial. The sore aspect in Denmark has been the creation of the bachelor perceived as a deficient degree. Thus, master conceptions generally persist unchanged: the standard five-year university education invalidating the bachelor as a terminal degree. This ontology seems shared among policy levels and is manifest both in conceptualisations across the board and in institutional implementation, with both academics and students envisaging a master qualification. The master continues to be the degree required on the job market and granting access to PhD, consensus being widespread about its double function across policy levels. There is also consensus about the crucial place of research in the master. Master conceptualisations thus display considerable similarity among Danish actors and this is reflected in implementation.

In Portugal, implementation of Bologna degrees represented a break from tradition through the reorganisation of the qualification framework and the shortening of degree durations. This is an example of European trends acting as catalysts with a ‘hegemonic quality’, having a sense of the irresistible, requiring the HE sector to become adept at manoeuvring and managing the environment not to be left behind (Trowler, Saunders, & Bamber, 2012, p. 227). Following the changes, the master has replaced the licenciatura as the fundamental level of university education in academic and student conceptions, resulting in the degree’s massification. Nonetheless, traditional ontologies colour current degree perceptions. The new master is described by reference to the old master as an inferior qualification, a hybrid between the previous licenciatura and master because of the diminished weight of research and the lower level of student knowledge. This conceptualisation shapes institutional implementation, with the Bologna master emerging as an adaptation of the two previous degrees. A contradiction is thus apparent between acknowledged implementation imperatives (i.e. modernisation) and loyalty to tradition reflected in reserved attitudes to the new degrees and implementation approaches, especially at institutional level. At political level, the vision for the master is that of a lifelong learning qualification, whereas academics and students see it as an initial training degree compensating for an insufficient bachelor. Like in England, this might be a consequence of the knowledge domain and epistemology specific to physics.

Comparing implementation levels across the three countries, the most notable difference in conceptualisation refers to the degree's purpose. Whereas the national (and European) levels unanimously view the degree as preparation for employment and further studies, physics academics and students describe it more as a springboard to a PhD (except in one Danish institution). This, again, is indicative of physics as a research-heavy discipline, a physics career being perceived as equivalent to a research one, thus requiring completion of a PhD. Despite disciplinary cultures becoming increasingly affected by global imperatives as shown by Trowler et al (2012), the discontinuity between dominant national and political conceptions and physics academics' conceptions demonstrates the persisting power of the discipline to shape academic culture and practice. These findings prove the strength of the disciplinary effect, capable of overriding prevailing discourses on the master's purpose.

2. According to the experience of academic staff and students, what are the continuities and differences in teaching and learning within physics master programmes in different European contexts of practice?

Continuities and differences in teaching and learning emerge as consequences of disciplinary features, national tradition and departmental teaching and learning regimes. They are manifestations of enacted ontology, i.e. the translation into practice of conceptions bearing the influence of the above factors. Similarities and differences are synthesised under the following categories: curricula, teaching and learning practices, assessment practices, transferable skills and learning outcomes.

Despite the strong classification characteristic of physics (Bernstein, 1971), the six degrees considered in this study do not display uniform *curricula,* as is the case with physics bachelor programmes (Kehm & Eckhardt, 2009). This derives from the master's focus on specialised advanced knowledge, which both academics and students in this research identify as a key marker of the degree.

However, *teaching and learning practices* are overall surprisingly similar, apparently due to disciplinary tradition. Lectures (expository) and problem-solving classes (interactive) prevail in the teaching of physics-specific courses according to academic and student accounts. As to variations, project-based teaching familiarising students with research tasks (outside the thesis) has been noted, as well as enabling courses (research, mathematical skills etc),. No clear national differences have emerged, differences being explained primarily by teaching and learning regimes. *Student learning*, too, displays more continuities than differences. Reading around lecture topics and problem-solving are the main activities students engage with. Variations appear in the timing of the reading (pre- or post-lecture), the degree of guidance, and the type of reading (textbooks, books, research literature).

Whilst teaching and learning practices share more similarities, *assessment practices* show more discontinuities, displaying both national and institutional characteristics. Physics disciplinary factors do not seem to impact significantly assessment forms. The predominance of the oral exam has been noted in Denmark, versus the written exam as the most common assessment method in England in Portugal. Especially in the English and Portuguese HEIs it is departmental teaching and learning regimes that determine practices, national influences being less visible. Programmes differ in two respects: the prevalence of summative or continuous assessment, and the variety of assessment methods simultaneously employed.

The prevalence of summative assessment has been noted in four of the six degrees studied here. Nonetheless, so has been the gradual incorporation of continuous assessment, a practice deliberately introduced in recent years especially in Portugal and Denmark. However, only in Portugal is growth in continuous assessment attributed to Bologna, whereas in Denmark it is explained by increased concern with completion times. One assists thus to the emergence of pedagogic practices which evolve from being loosely-coupled to being 'tightly-coupled to outside determinants in which external changes and imperatives increasingly exert influence on how academics behave' (Trowler, et al., 2012, p. 230).

One similarity in assessment is its focus on the understanding of physical laws and principles, physical intuition and reasoning and problem-solving. Factual knowledge is thus a means to an end rather than an end in itself. Students are expected to solve problems and apply knowledge to new contexts which require a broad overview and higher level understanding of concepts, laws and interconnections. Unanimous agreement among academics and students thus emerges of application and interpretation being the favoured modes of knowledge use in the physics MSc programmes considered here (Eraut, 1985).

A generally low emphasis on *transferable skills* has been noted. Academics have, in fact, often understood ‘skills’ as problem-solving. Skills appear to be eclipsed in physics by the primacy of scientific, cognitive content. It is thus embrained knowledge as opposed to embodied knowledge (Blackler, 1995), propositional knowledge rather than skilled behaviour (Eraut, 1994) that appears paramount in physics. Two degrees offer tailored courses for transferable skills development, whereas in the others skills are trained implicitly. Although skills deemed useful in a research career and environment (presentation, communication, interpersonal skills, team-work etc) appear to be valued, they do not get much weight in assessment.

Differences anchored in national tradition emerge as to *learning outcomes*. They illustrate the relationship between implicit theories of learning and teaching and actual practices, as well as the primacy of the former over the latter. Thus in England learning outcomes are recognised and applied conscientiously, theory and practice being consistent. In Denmark, although the practice is new, it seemed relatively easy to implement because it found correspondence in student-centred pedagogic theories. In Portugal, where pedagogic assumptions have been teacher-centred, the implementation of learning outcomes has so far emerged as superficial.

Practices related to learning outcomes appear somewhat indicative of national pedagogic approaches. In England the link between learning outcomes and teaching design emerges, and interviews highlight student-driven learning. In Denmark a focus on improved pedagogy aims to address completion times and student employability in curricula, while interviews highlight student independence and project-based teaching. In Portugal official documentation refers to the abolition of the traditional pedagogic paradigm, while interviews document change in progress despite multiple interpretations of student-centred education. The introduction of new pedagogic practices in teaching repertoires appears as a Bologna consequence.

Nonetheless, the pedagogic approaches of the investigated master degrees, student-centred or teacher-centred, do not always mirror national pedagogic tradition. For example, one Portuguese degree appears student-centred to a great extent. Thus degree framing (Bernstein, 1971) evident in teacher-student relationships is not a national variable. It is mainly an institutional one.

One interesting aspect concerns the relationship between tacit assumptions and rules of appropriateness on the one hand and recurrent practices on the other hand. According to Trowler & Cooper (2002), the former underpin and shape the latter. Portugal is in this respect a case worth noting. Although student-centred education is not yet a clear concept, yet to be embedded in assumptions and rules of appropriateness, the emergence of student-centred practices is incontestable. A question thus arises whether practices are capable of triggering change in assumptions and rules of appropriateness.

3. What does the comparison between master programmes overall, and physics in particular, suggest about the nature of the degree?

Bologna recommendations envisaging convergence rather than harmonisation act as relative structural references which can be interpreted flexibly. Beyond that, as regards conceptualisations of the master degree and learning and teaching practices – that is, ontologies and enacted ontologies – variation appears even wider on account of national, institutional and departmental idiosyncrasies. Disciplinary traditions, as noted in the case of physics, can also explain differences in ontology and enacted ontology between national actors on the one hand and academics and students on the other hand. The identification of absolute references to define the nature of the master degree becomes therefore problematic.

The master's purpose and relationship with the bachelor fail to attract consensus. European and national political visions describe it as a lifelong learning qualification allowing people to retrain throughout their professional lives to acquire skills relevant to economic and job market needs. However, in Portugal and Denmark the master is still perceived as essential initial training complementing the bachelor. In England, it appears that the lifelong learning, continuous training, function is generally the rule. Nevertheless, in physics the master is perceived as fundamental training for a professional career. The explanation probably lies in the discipline's atomistic and cumulative nature and long maturation period – hence the concern with the length of a degree perceived as fundamental initial training. Once again, this corroborates the powerful disciplinary effect referred to earlier.

It remains to be seen, however, whether the master in general will turn into a lifelong learning qualification in a context of massification and increasing costs of higher education or whether disciplinary differences will persist.

Nonetheless, consensus does exist around a number of issues at all policy implementation levels. For instance, the master is universally seen as the educational level where students become independent learners capable of taking responsibility and initiative for their studies. It is also understood as a degree focused on specialisation and advanced knowledge, building on the broad curriculum covered during undergraduate studies. Research as an essential component attracts general agreement, too, and for students research is its outstanding dimension. It is worth noting that these widely recognised characteristics all feature in the Dublin descriptors for the second cycle. This might be indicative of the fact that learning outcomes as qualification markers are capable of attracting widespread agreement, contrary to input descriptors. Commonalities can also be discipline-specific. At institutional level among the Physics MSc programmes considered here, common core teaching and learning practices have been observed, as well as shared preoccupations with knowledge application and problem-solving.

I earlier referred to the ontology of the master to describe the degree's understanding and conceptualisation. Insights from the first two questions imply the *situated ontology* of the master despite common reference points meant to act as guidance for degree design. Except similar structural features in which the sampled degrees are mindful of Bologna guidelines (i.e. second cycle qualification or credit range) and the characteristics mentioned in the previous paragraph, variation in the conceptualisation of the degree primarily by country, but sometimes also by institution, has been observed. In addition, learning and teaching regimes (i.e. their tacit assumptions and rules of appropriateness) conceive of knowledge codification, transmission and evaluation differently as a consequence of departmental culture and tradition.

The epistemological underpinnings of this research establish links between socially-constructed meanings and behaviour (Berger & Luckmann, 1967; Geertz, 1973). The findings of this study corroborate this assumption. One noteworthy contribution of this research is therefore an illustration of how *implementation* is sensitive to *ontology* and vice-versa. The two thus cannot be considered in isolation as parallel phenomena. First, conceptualisations of the degree exert influence on the interpretation of new education policies and the choices made during implementation (i.e. the English reticence to credit and length as degree descriptors). Second, educational policies in turn have the power to shift ontology. New national imperatives can act as catalysts and determinants of new academic practice (Trowler, et al., 2012), as has been observed in Portugal which has embraced the idea of a new pedagogic approach further to Bologna and is gradually changing teaching methodologies.

Therefore, the forms of a master degree materialised in recurrent pedagogic practices – or *enacted ontology* as described earlier – emerge from the interplay between ontology and the process of implementation mutually affecting each other. Thus, in order to understand the process of change triggered by the Bologna Process, one should be mindful both of the ontology manifest in context-determined encultured knowledge and tacit assumptions about the master as an educational knowledge product and to the implementation process and the selections occurring therein.

To conclude, master degrees can be different things in different contexts, even in a highly classified discipline like physics. For the ‘zones of mutual trust’ (Kehm & Teichler, 2006) to exist, one must acknowledge the degrees as enacted ontology, resulting from the interaction between situated degree conceptualisation and the implementation process. This comes to support the claim that a transparency and convertibility approach (Wächter, 2004), rather than a convergence approach, is better suited to the Bologna Process to facilitate degree comparison and recognition.

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