

**Investigating digital agility: Using a chatbot to scaffold learning  
opportunities for students**

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This thesis is submitted in partial fulfilment of the requirements for the degree  
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This thesis results entirely from my own work and has not been offered previously for any other degree or diploma.

The word length of the thesis does not exceed the permitted maximum.

Signature .....

## **Investigating digital agility: Using a chatbot to scaffold learning opportunities for students**

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### **Abstract**

This research investigates how humanities students develop digital agility through targeted digital supports throughout their degree. Ensuring higher education students are digitally agile is of interest to academics in other degree programmes. Based on students' prevalent use of text messaging, a chatbot was chosen as the platform to provide these supports. This research found it valuable to think through a self-regulated learning lens to ascertain the variety of needs and competencies that support students in their studies and in the future. The synthesis of digital competencies frameworks and policy documents provide an understanding of the diversity of competencies needed in this evolving landscape. Incorporating learning agility and design provides a holistic understanding of evolving digital needs. My definition of digital agility is the agency to use technology to create, design, communicate, collaborate and thrive in a changing digital landscape. A design-based research approach was chosen as it provides a balance of theory, artefact design and practice. Design-based research facilitated collaborating with students and academic staff over three iterative cycles of design, development, and evaluation, that shaped and aligned the chatbot to provide students with timely digital supports. The findings present that this collaboration with students and academic staff is needed to ensure alignment with disciplinary digital needs. Findings also highlighted the significant role assignment requirements play in driving digital agility. The main contributions to knowledge are: a digital agility framework incorporating: management of learning agility, research, communication, collaboration and data agility; design principles for future researchers to create their own intervention; and an improved understanding of the needs of students in support of their digital agility. Recommendations for practice and policy are also

discussed. A limitation of the study is that it is confined to one degree programme in one institution during one academic year.



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## List of abbreviations

AI	Artificial Intelligence
API	Application Programming Interface
BA	Bachelor of Arts
CASA	Computers As Social Actors
CSAT	Customer Satisfaction
CAQDAS	Computer Assisted Qualitative Data Analysis Software
CUI	Conversational User Interface
DBR	Design Based Research
DELT	Digitally Enhanced Learning and Teaching
DigCompEdu	Digital Competence of Educators
DOI	Digital Object Identifier
EU	European Union
EUA	European University Association
GDPR	General Data Protection Regulation
HE	Higher Education
INDEx	Irish National Digital Experience
IM	Instant Messaging
IT	Information Technology
JISC	Joint Information Systems Committee
LifeComp	Life Competence 2020
LMS	Learning Management System
MS	Microsoft
NLP	Natural Language Processing
OECD	Organisation for Economic Co-operation and Development
PDF	Portable Document Format
PLC	Professional Learning Community
PVA	Power Virtual Agents
RIS	Research Information Systems
RQ	Research Question
SRL	Self-Regulated Learning
TEL	Technology Enhanced Learning
UDL	Universal Design for Learning

UGD	Undergraduate Dissertation
UK	United Kingdom
WEF	World Economic Forum
XML	Extensible Markup Language
ZPD	Zone of Proximal Developmental

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# **1. Introduction and background**

Students and academic staff are sensitised to the importance of developing their own respective digital competencies, literacies, fluencies and skills; however, assistance is required to achieve these skill sets. This study levered the collective wisdom of students and academic staff to ascertain the variety of digital requirements over the course of a Bachelor of Arts degree and incorporated this information to develop a digital agility framework. This chapter starts by introducing the rationale for this study, and then the next section introduces the Irish National Digital Student Experience (INDEx) report that is used as secondary data. The next section provides readers with a background of support available at present to students, and this is followed by an overview of the solution. Then digital agility is introduced, and the research approach used for the study. The research questions, the contribution of the research and intended audience follow. The next sections describe how this research fits in the field of Technology Enhanced Learning (TEL), and the researcher role at the research site. The last section outlines the organisation of the thesis.

## **1.1. Rationale**

At present, humanities students in my college, a higher education setting, receive digital competencies training in conjunction with academic writing and research methods to scaffold their studies in year one of the degree programme. Most students do not receive any other digital scaffolds unless they undertake psychology or a specific elective module in Information Technology (IT) in the second year of their degree. The research problem is how to sustain and advance students' digital competencies throughout the four years of the humanities degree programme to meet the needs of diverse disciplines and the changing digital landscape. This research explores the digital narrative to provide a holistic view of the contemporary digital landscape including digital competencies that students undertaking a humanities degree need to upskill during their degree. This research includes the examination of policies that influence the higher education landscape.

## **1.2. Policy**

Policy inclusion is important as findings from student voices, the Irish National Digital Experience INDEX (National Forum, 2020b) (note the response rate was 11%, 25,484 students) reported only four in ten students said they had regular opportunities to review and update their digital skills (National Forum, 2020b, p. 10). Three-quarters of all students agreed that digital skills are essential for their chosen career but fewer than half believed that their course prepared them adequately for the digital workplace (National Forum, 2020b, p. 12). This research encompasses the need to embed digital competencies awareness throughout their degree programme. Bachelor of Arts (BA) students in first year receive two modules to prepare them for college and work that is outlined in the next section.

## **1.3. Background of first year IT component module information**

This section is included to provide the reader with a brief overview of learning and digital competencies which our students receive. First year BA students receive one hour face-to-face practical IT classes each week for two semesters. Including digital supports as an integrated part of the BA degree highlights the college's commitment to providing digital help for students. This is a longitudinal commitment as these supports were designed as part of the humanities degree programme development 25 years ago. The IT component builds on students' digital capabilities and aims to instil a culture of digital innovation, creativity, critical thinking, communication, collaboration and lifelong learning in the evolving technological landscape. The modules are designed in consultation with academic staff and students on digital competencies, digital literacy and digital fluencies required to achieve success in their college studies and future work. Furthermore, these modules are designed and developed to take cognisance of the frameworks described in section 3.3, specifically DigiComp. The inception of the AllAboard map (AllAboard, 2015) for digital competencies of students and staff in higher education confirmed that the modules are innovative and evolving with this changing landscape as these first year IT skills modules aligned with the majority of digital elements depicted in the map. The students' active learning classroom environment is supported by exemplars of

pre-defined criteria of digital use (best practice examples), screencasts, instructional handouts, multimodal resources, and a collaborative and communicative space that scaffolds a community of practice in digital innovation. The modules focus on the broad non-discipline digital competencies to help our humanities students in:

Developing best practice Boolean search, awareness of their digital footprint, digital security, privacy and digital wellbeing, and curating an online presence;

Designing a digital portfolio to document course work;

Creating documents with best practice use of styles, pagination, referencing, illustrations, graphics and accessibility;

Creating presentations using best practice design, styling, accessibility, visualisations, animation, transcript, translate and recording functions;

Creating forms to collect and analyse data;

Creating spreadsheets for data creation, sorting, formatting, filtering, editing, charting, visualising, and pivoting data;

Designing dashboard to present data and using formulae to organise and present insights into data and present a data story;

Collaborating and communicating using features in *Microsoft 365* for college projects, group work and future work;

Using a variety of apps to manage and organise students' learning.

To ensure students build on these competencies, I am creating an intervention with the aim to sustain and embed digital agility over the four years of the degree programme. This is discussed in the next section.

#### **1.4. My solution**

To address the problem of sustaining digital competencies throughout an undergraduate humanities degree programme, I researched into the design and development of an intervention in the form of a chatbot. A chatbot or bot is a text-based conversation agent or virtual assistant that is designed to automatically answer a set of related questions or simulate a text-based conversation (Pereira et al., 2019; Villegas-Ch et al., 2020). Chatbots provide

anonymous, asynchronous, anytime, and scalable supports (Villegas-Ch et al., 2020). The use of chatbots in education is not a new topic; however, there is insufficient research in technology enhanced learning literature on using chatbots to scaffold students' digital agility or design principles for chatbots for supporting digital agility. To the best of my knowledge, purposely building a chatbot to scaffold students' digital agility over a degree programme is unique and novel. Another novel factor is the contribution of students to shape the design and development of the chatbot. In addition, academic staff were facilitated with the opportunity to input their specific disciplinary digital requirements.

Digital competencies across our student body are inconsistent and the creation of a chatbot sought to address this as students had access to it anytime. The learning and digital competencies detailed above in section 1.3 are embedded into the chatbot and allow students to build and learn over their degree. Our Liberal Arts degree nurtures a variety of transferable skills, for example critical and analytical thinking and how to build a complex argument. The inclusion of digital agility adds to these transferable skills. To date, there is no evidence of chatbot being used to support learning in my college or from my studies in Lancaster University, and I hope this research will open a conversation and drive innovation within the field of learning and technology use. This research could be replicated for use in other degree programmes and in other institutions to embed digital agility into the mindset of both students and staff. The next section outlines my digital agile narrative.

### **1.5. Digital agility**

The definition I use for digital agility is the agency to use technology to create, design, communicate, collaborate and thrive in a changing digital landscape. This definition builds on the narrative of digital competencies, digital skills, digital literacy and digital fluency that will be used sometimes interchangeably in this thesis as academic staff and literature sometimes blur distinctions between these narratives. To drive this digital agile journey, learning spaces should support diverse learners with their variety of prior knowledge and specific needs. As educators, communication, collaboration, critical thinking and

creativity in module designs should be promoted (Carretero et al., 2017). Learning spaces should facilitate multiple alternative opportunities for students and lecturers to interact (Mayer, 2009). Additionally, students need to embrace and manage or self-regulate their learning. Self-regulated learning (SRL) is a process of setting goals, managing workload and tasks to achieve a learning goal (Zimmerman, 2002). The process of self-regulation can be supported by a knowledge of technology that enhances and manages workflow efficiently and effectively. Boekaerts (1997) recommends awareness of prior knowledge in learning design. Learning spaces should help students “self-scaffold their learning process” (Boekaerts, 1997, p. 174) and teachers should design tasks to “ameliorate planning, initiating and completing intended actions” (Boekaerts, 1997, p. 182). Students can use the chatbot to self-scaffold their learning and leverage technology to help plan and complete their work. The next section presents the research approach in this study.

## **1.6. Research approach**

This study uses design-based research (Brown, 1992; Collins, 1992) to investigate the learning design of the chatbot, the student experience of self-regulated learning using the chatbot and academic staff discipline digital requirements to incorporate into the chatbot creation. Educational design research “sets out not only to understand a problem, but to solve it” (McKenney & Reeves, 2019, p. 238). Design-based research (DBR) exploits the opportunity for researchers and stakeholders to learn from the research (Edelson, 2002). The design-based research methodology uses multi-ontological frameworks, several theories and variables (Barab, 2014; Hall, 2020). This research incorporates theory on self-regulated learning (SRL) (Zimmerman, 2000), digital competencies frameworks (AllAboard, 2015; Carretero et al., 2017; Ferrari, 2013; JISC, 2019; OECD, 2021; Sala et al., 2020), learning agility (De Meuse et al., 2010; DeRue et al., 2012; Hayward, 2018) and design (CAST, 2017; Nielsen, 1994; Shneiderman, 1985). The research distils from literature a theoretical understanding of practice and how practice can be improved through iterative design, development and testing the intervention (McKenney & Reeves, 2020). Collaboration with students allows the research problem to be



developed and shaped (McKenney & Reeves, 2020). The voice of the learner is essential throughout problem analysis, design and development, evaluation, redesign and redevelopment stages (Edelson, 2002). The “relationship among educational theory, designed artefacts, and practice” (The Design-Based Research Collective, 2003, p. 5) underscored my choice of design-based research.

This “practically focused but theoretically robust” (Hall, 2020, p. 157) approach cultivates learning, develops sharable usable knowledge and theories over cycles in authentic settings that is documented (McKenney & Reeves, 2020; The Design-Based Research Collective, 2003). The designed artefact, the chatbot, creates a learning space that provides self-regulated learning opportunities for students to broaden their digital agility. Students were involved in the process of testing and conveyed continuous feedback during the construction process and this allowed them to direct their learning environment. The evaluation of this learning space revealed a positive student experience and calls attention to the digital needs of this cohort. Academic staff who expect a variety of digital competencies from their students were also consulted. A pragmatist stance was taken as this aligns with my agile metaphor, methodology and the importance of continual learning. The next section will outline my research questions before outlining my contribution to the TEL field of research and practice.

### **1.7. Research questions**

The aim of this research is to investigate how a chatbot can be designed and developed to scaffold students’ digital agility, to investigate student experience of SRL with the chatbot and to provide recommendations for others to use in their own design and development activities.

Research Question 1 (RQ1): How can a chatbot be designed and developed to support students’ self-regulated learning of digital agility?

Research Question 1.1 (RQ1.1): What perceived benefits and limitations did students present in the design and development process?

Research Question 1.2 (RQ1.2): What digital questions were not anticipated and should be included in the chatbot knowledge base?

Research Question 2 (RQ2): What are the students' perceptions of the chatbot for supporting their digital agility?

Research Question 2.1 (RQ2.1): What factors will enable students' self-regulation?

Research Question 2.2 (RQ2.2): What factors will hinder students' self-regulation?

Research Question 3 (RQ3): What recommendations are there for designing and developing a chatbot to support students' digital agility?

### **1.8. My contribution to research**

There is a paucity of research in the field of TEL that focuses on how to exploit a chatbot to imbue self-regulated learning (SRL) strategies to develop students' digital agility. This study contributes to knowledge by:

1. Providing a digital agility framework incorporating, management of learning agility, research, communication, collaboration and data agility.
2. Presenting design principles to design the intervention based on my experience developing the chatbot and findings from students using the chatbot.
3. Providing an improved understanding of the needs of students in support of their digital agility.
4. Presenting recommendation for policy and practice.

The narrative of the National Forum findings representing the voices of students reported students want opportunities to improve their digital competencies (National Forum, 2020a). This is reiterated at European level in the digital education action plan (European Commission, 2020). My research specifically embeds digital agility as a spine in a degree programme and propagates a strategic digital vision among academic staff and students. As educators, a proactive approach is required to discover insights into digital expectations of our

students and other academic staff. The expectations of educators should be aligned to support and enhance the digital agility of students. To this end, the following section outlines the intended audience for the research.

### **1.9. My intended audience**

While this research is situated on the digital expectations of a Faculty of Humanities in a College of Education and Liberal Arts, the findings could be replicated to a wider audience. “Educational environments, like all sectors of society, seek to evolve, improve the services and experience of its members” (Villegas-Ch et al., 2020, p. 1). Education leaders, academic staff, technology learning support staff and administrative staff should benefit from this research as findings could be replicated by other academic staff to provide a learning and skills enhancement space for their students in parallel with improving academic management capacity. Education leaders may benefit from this research that highlights the importance of a curated approach to building digital agility. Learning technologists could replicate this model to design a space where they can provide questions and answers on technology use. TEL researchers who are interested in chatbot research and practice could use and build on this research. Administrative staff could model this, for example, a human resources department could create a question and answer space for staff. Another cohort that should benefit from this research are future PhD students in Lancaster University and other universities by bringing attention to DBR as an alternative methodology to use for their studies. As a teacher, I am documenting this process with the aim to provide readers with new tools, functionalities, and the momentum to instil digital agility into the mindsets of their students and encourage their lifelong learning journey. The field of TEL is a lifelong learning journey, and the next section shows where this research fits into the TEL research landscape.

### **1.10. My research fit in the field of Technology Enhanced Learning**

The Technology Enhanced Learning (TEL) field of research and practice is a multidisciplinary field that encompasses education and technology. This research incorporates research that places pedagogy as a central driver for

technology use. The important balance of theory and staying abreast with technology changes is also central to the field of TEL. The value of communication and collaboration with students and academic staff and listening to their discipline and pedagogical needs and adapting to technology innovations is critical to successful interventions. This research suggests this and the position of a leader to communicate, collaborate, curate and drive digital agility. The use of the chatbot provides a scalable solution to advance students' digital agility, but only if the construction is grounded in the importance of pedagogy, expertise of human input and communication and collaboration with students and academic staff. As educators, we are constantly striving to provide our students with opportunities for learning and skills enhancement. The next section describes my educational experience and my role at the research site.

### **1.11. My role at the site of research**

As a teacher, one of my roles in my college is to teach digital competencies to first and second year Bachelor of Arts students. The design of these modules, to support students' digital competencies, lies with me. My undergraduate degree in mathematics and economics and my three postgraduate degrees, Higher Diploma in Education, Higher Diploma in Applied Science and Master of Arts in E-Learning Design and Development, provide a holistic spectrum straddling humanities, education and sciences. In the same vein, experience working on Erasmus+ projects, for example "School on the Cloud", and participating in eight Erasmus training programmes has ensured that I have kept abreast with educational technology trends and educators at European level. This prior learning brings a wealth of prior knowledge that I infuse in my teaching. As an insider researcher, I have benefited from understanding the education setting and from twenty years working in this area, I have longitudinal insights into students' digital needs.

My problem statement was while students get substantial digital supports in their first year, they tend to forget these until they are required later in the degree, for example, for their undergraduate dissertation (UGD). To this end, and to meet the continuous evolving changing digital landscape, I built a

chatbot. This chatbot allowed me to curate the digital agility of all our Bachelor of Arts students. This I did with valuable communication with students and academic staff. These insights shaped the formulation of my chatbot, and they ensured interdisciplinary digital knowledge in conjunction with digital knowledge that was relevant to all disciplines. The concluding section of this chapter outlines the organisation of the thesis.

## **1.12. Organisation of the thesis**

Chapter two highlights the diverse literature, on a digital narrative, associated student experience, self-regulated learning, learning agility, chatbot overview and design and learning design, that influenced this research process. Chapter three synthesises the literature in chapter two and uses the lens of self-regulation to examine how best to build digital agility in students. From this, a digital agile conceptual framework is developed. Chapter four outlines the approach of design-based research and the process used in this research. Three iterations of findings are elaborated in: chapter five, findings from a prototype stage; chapter six, cycle 2; and chapter seven, cycle 3 the final stage. Chapter eight discusses these findings and chapter nine concludes the study by outlining implications of the study for practice and policy, then considering limitations and future research. These chapters represent a linear overview of this thesis, but in reality, the study developed by reflecting on feedback from students using the chatbot and continuous engagement with the literature throughout the study. Figure 1-1 visually represents this evolving development process.

The initial study considered the research problem to sustain and develop students' digital agility over their degree. An extensive literature review was undertaken to gain a broad understanding of themes and this literature provided the foundation for the design principles. The literature in addition to communications with students and academic staff provided insights to develop the digital agility conceptual framework. Next the chatbot was developed and from students testing and providing feedback on using the chatbot this led to further analysis, a further literature review, redesign, development and testing

were undertaking. This process is described over the chapters in the thesis. The next section addresses the literature.

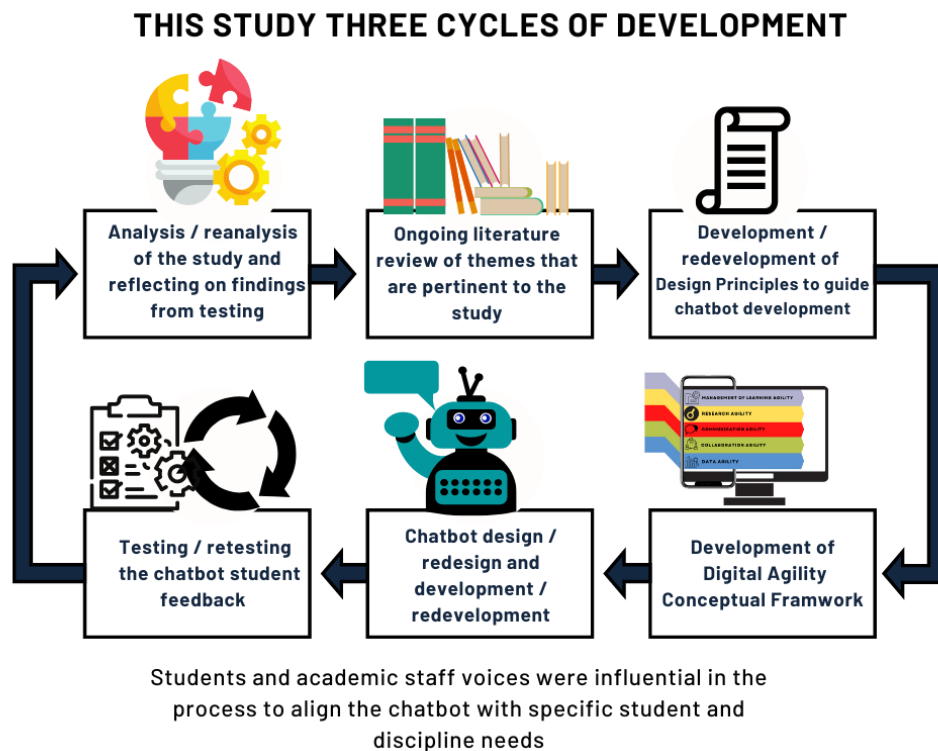


Figure 1-1 Study development overview

## 2. Review of literature

This chapter examines a broad range of literature. Figure 2.1 presents a visual of topics reviewed and how my research connected them. Self-regulated learning (SRL) plays an influential role on learning and academic outcomes. Drilling into the different SRL strategies that can support students' learning and leveraging technology to assist SRL provided data to include in the chatbot design to support students' learning. Effective SRL strategies that support student engagement and policy in higher education are also influential. The digital narrative highlighted the wide use of language used in the literature. An overview and examples of chatbots used in education highlighted that there was a gap in the use of chatbots to support students' digital agility. Research into chatbot design highlighted the gap in the literature of chatbot design principles to develop a chatbot to support learning. The inclusion of literature on learning design and learning agility added another dimension to my research.

### Literature review

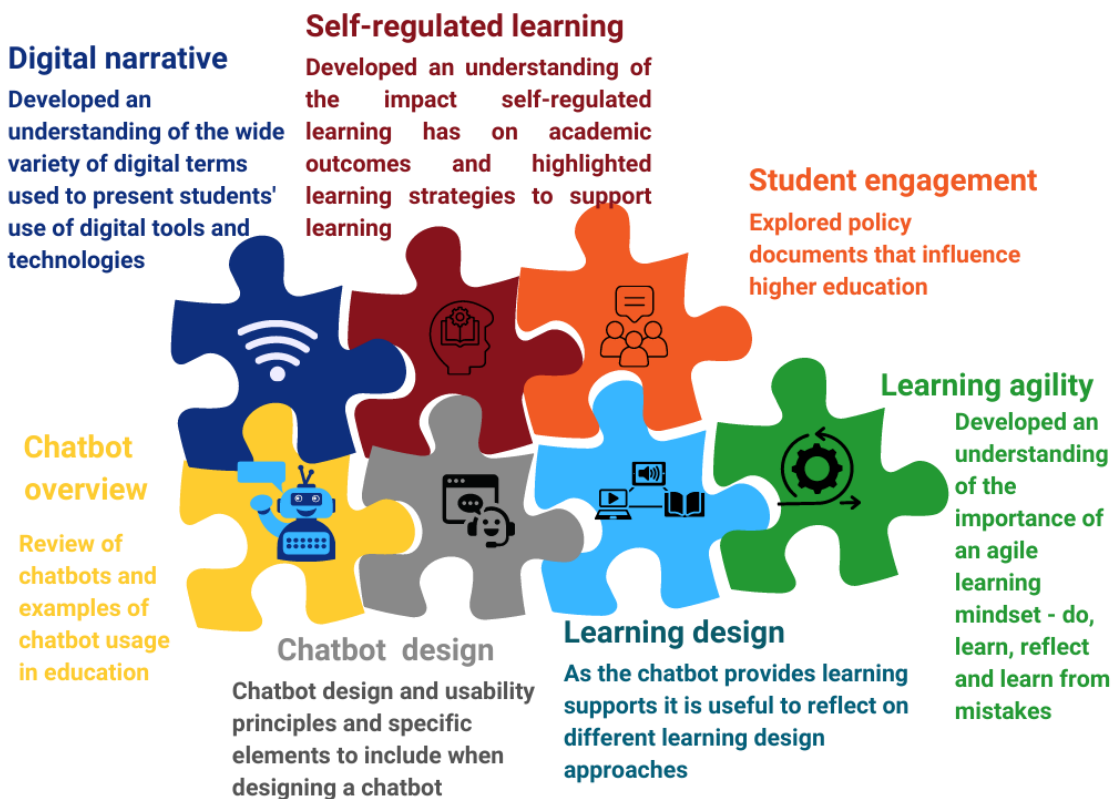


Figure 2-1 Literature review topics

This review opened new perspectives, reinforced others and helped to interrogate my thinking. Firstly, my literature search process is communicated.

## **2.1. Literature search process**

My literature search in OneSearch, the Lancaster University Library database, Google Scholar, ResearchGate, Web of Science, Scopus and traditional search engine Google encompassed a broad spectrum of areas that supplied a foundation base and background knowledge for the research, and construction of my artefact. As Technology Enhanced Learning (TEL) is a multi-disciplinary field, it was better for me to include both research and practice papers. My inclusion criteria were limited to work published in English and peer-reviewed articles in the last ten years but this date was expanded to include research that other researchers had built on. I focused on the search terms, as there was a range of terms used to convey similar research. My keywords were bot, chatbot, conversational agent, pedagogic conversation agent, virtual assistant bot, dialog system, digital competencies, capacities, literacies, fluencies, chatbot design and development, interaction design, usability, agile, learning design, learning agility, education agility, growth mindset and self-regulated learning of students in the context of higher education. These keywords encompass the diversity of areas pertinent to consider when designing supports for students. I used Boolean searching for keywords. The conjunction “AND” narrowed the search considerably (for example “Chatbot” AND “Self-Regulated Learning” AND “Digital Agility” AND “Higher Education”) while using the Boolean OR enabled opening the search to a larger number of potential sources (for example “Chatbot” OR “Higher Education”). I used the wildcard \* in the search criteria to include the singular and plural forms, or different words used in different contexts, for example, bot or chatbot, “\*bot” AND “\* Education”. In this iterative process to remove unrelated results, the conjunction “NOT” was used.

I replicated these search terms in different places mentioned above. My research overviewed 90 articles on self-regulated learning, 53 on agility, 247 in digital literacy, 49 on design-based research, 92 on chatbots and 51 on ICT in higher education. My EndNote library has 298 articles. To explore connections between papers and authors, I used the website <https://www.researchrabbit.ai/>.



This website helped to build a comprehensive search process, by using the software to follow up on authors and journal articles. Journals categorise each paper uniquely and provide the options to Save to Refworks, Export citation to RIS (Research Information Systems), Export citation to BibTeX or Export citation to text, to organise referencing dependant on referencing software requirements. To manage my literature and referencing I used *EndNote* and *EndNote Click*. *EndNote Click* is a free browser extension that I signed up with my Lancaster account and that I used as my locker to store files with a DOI (Digital Object Identifier). This enabled a seamless workflow to open, save and read files. It also facilitated transfer of the portable document format (PDF) and referencing data to my *EndNote* desktop library in one click, by creating a RIS file format that contains citation information for the publication that can be added to any referencing software. This research management is referred to in subsection 4.5.5.

These results were reviewed and screened on title, keywords and abstract. I identified publications on the digital narrative from a higher education perspective with a focus on humanities students' digital needs. In addition, the review included the design and development of learning artefacts from within these bodies of knowledge and, from abstracts, selected works that showed sufficient topic focus. It was important to review research outside the TEL narrative to gain my holistic understanding of design and development. These publications included policy documents at national and international level, for example, the INDEX survey and European education action plan. I added my literature to my *EndNote* project for referencing and to my *NVivo* project space for additional document management and data analysis (see subsection 4.5.5).

The current chapter discusses digital narrative, student experience, self-regulated learning, learning agility, chatbot overview and learning design. Together, this provides a comprehensive overview of the different research narratives that have impacted this study.

## 2.2. Digital narrative

The narrative of digital skills, competencies, capacities, literacies, fluencies is extensive and the importance of these for students is extensively researched. There are numerous frameworks on capacity building and an extensive research body of knowledge. I explored a selection of these frameworks, for example, the European Digital Competence Framework for Citizens (Carretero et al., 2017) focusing on information and data literacy, communication and collaboration, and digital content creation. I also examined the European DigiCompEdu framework for teachers (Redecker, 2017) but focused on the learners' competencies of empowering learners, transversal competencies, digital competencies and subject specific competencies. In Ireland, the National Forum created a bespoke metro map to capture the diverse range of practices and capabilities students and academics should acquire to navigate the evolving digital landscape (AllAboard, 2015). These frameworks capture and describe competencies from a variety of different narratives and are explored in section 3.3.

This study is situated in the context of digital competencies of students in an undergraduate humanities degree and have taken cognisance of Brown's assertion that "there is a risk that many current digital literacies models and frameworks lack contextual validity anchored in situated practice and promote false clarity of what remains a messy construct" (2017, para. 16). Educators need to actively prepare students to deal with this complex digital landscape. Equally, an awareness of the frameworks mentioned above yielded structure to create my chatbot. Johnston et al. (2018) are critical of universities' responses to embracing digital technologies that would transform practices. They pose the question "are we supporting our students to use digital technologies to communicate, create, and collaborate in ways that reflect how they will be required to engage digitally to communicate, create, and collaborate beyond the university and life-wide contexts?" (Johnston et al., 2018, p. 134). Interviews with academic staff explored a variety of digital technologies they need for their discipline (Varga-Atkins, 2020). This spectrum of knowledge facilitated the development of a framework that represents a holistic narrative of digital use

across the degree. It was also important to be aware of the broad digital narrative to take this into account in my research.

In my design and development, I was mindful of the importance of prior experience and exposure to a variety of technologies as playing a significant role in users' ability to adapt to the changing technological landscape (Park, 2017). Park presents the concept of digital capital as "a personal digital readiness ... determined by pre-existing conditions" (2017, p. 27). It is this variety of interdependences among digital confidence, digital fluency, digital literacy, digital skills, digital media, digital or technical proficiency, that build digital capital (Park, 2017). This variety of influences is said to predispose users' ability to embrace the evolving landscape. Digital technologies continuously evolve and update and build on existing features, so it is imperative that users continue to accumulate a skill set over time, to build their digital capital to keep up with this evolving landscape (Park, 2017). To add to the complexity, this continuous digital capital development also needs to be cognisant of unlearning some old ways of doing things. "Not all knowledge and skills are transferable to the next technology, meaning sometimes there has to be an unlearning process before learning a new skill" (Park, 2017, p. 188). Other researchers have echoed this, calling on higher education to reimagine their learning provisions as students need to "learn, unlearn and relearn to retune and upskill throughout their lifetime as the velocity of skills demanded by employers is increasing" (Anthonysamy et al., 2020, p. 2394). Old knowledge can sometimes prevent us from moving forward, hence unlearning is an important skill to allow us the agility to learn new skills (Sierra, 2005; Wheeler, 2019). This awareness of prior learning, understanding of the changing technology landscape and the concept of unlearning, is central to promoting agile students.

Passey et al. (2018) argue for Digital Agency that incorporates a holistic broad digital narrative of "digital competence, digital confidence and digital accountability – is the individual's ability to control and adapt to a digital world" (p. 426) and the important role educators play in modelling this. They called on policy makers, educators and employers to embrace digital agency "as a

lifelong learning skill, evolving along a continuum” (Passey et al., 2018, p. 436). This is valuable research as it aligns with my thinking on the variety and complexity of the digital landscape, so to this end, I use the concept “digital agility” to place the emphasis on the nimbleness of change and the importance of keeping up with technology changes through learning, unlearning when appropriate, and relearning so as not to use outdated methods.

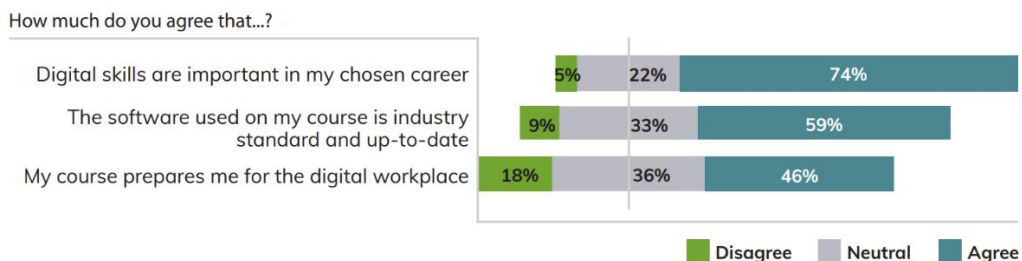
Martzoukou et al. (2020) argued in conjunction with abilities, competencies, capabilities and skills, a digital mindset of attitudes and behaviours is needed for student lifelong learning (Martzoukou et al., 2020). Martzoukou et al. (2020) claimed that universities have not yet prioritised a systematic approach to technology and digital citizenship. The focus is on baseline skills of the academic environment but “no systematic attempt is made to understand students’ existing digital competencies within the continuum of students’ lives looking at already developed digital skills, attitudes, beliefs and behaviour influence subsequent interactions with digital environment” (Martzoukou et al., 2020, p. 1415). This knowledge of prior digital learning and mindset is important to establish as it provides a strong or weak foundation depending on whether the student has an open or fixed mindset in relation to digital use. I concur that unpacking this will assist students to evolve and be more open to this constantly changing landscape. Dweck (2016) believes that nurturing and development can produce a “growth mindset” (Dweck, 2016). To this end, I have created a digital space that allows students to evolve at their own pace. This space provides resources to scaffold digital best practice in their degree thus obviating a static mindset in relation to digital use – i.e. ‘this is the way I always did this!’ A digital agile support space provides the scaffolds to facilitate students to continuously improve and take advantage of functionalities and changes with technology. Creating a space for students to use will enhance their student experience and empower them to proactively seek to improve their own digital agility. My focus is on higher education students and the importance of embedding not only a digital mindset but one that is agile to guide them in this evolving digital landscape.

### 2.3. Student experience

The improvement of student experience and facilitation of partnerships is a recent evolving rhetoric in Higher Education (HE) in Ireland (HEA, 2017). The establishment of a national HE policy and a National Forum for enhancing teaching and learning in HE situate teaching and learning and digital capacities as key elements in Irish Higher Education (HEA, 2018; National Forum, 2014). Two strategic priorities in the Digital Education Action Plan (2021-2027) from the European Commission echo this student experience narrative:

1. Fostering the development of a high-performing digital education ecosystem and
2. Enhancing digital skills and competences for the digital transformation. (European Commission, 2020)

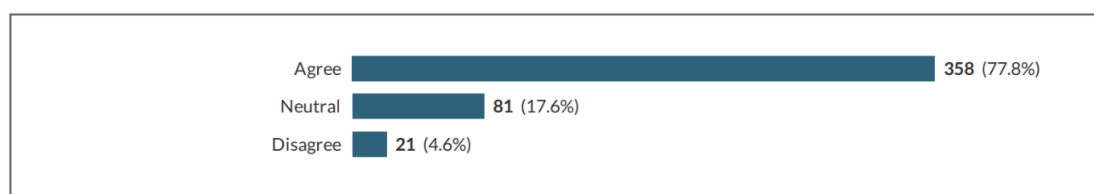
Another timely report that documents our students' voices is the Irish National Digital Student Experience survey INDEx report (National Forum, 2020a). This provided secondary data for my research from both a national and an institutional level. A key point stood out for me in this report as stressed in chapter 1, namely that only four in ten students reported they had opportunities to review and update their digital skills (National Forum, 2020a, p. 63). This statistic is stark as three-quarters of students agreed that digital skills are important for their chosen career but less than half believed that their course prepared them for the digital workplace (National Forum, 2020a, p. 65) (see Figure 2-2). Notably 59% agree that the software is industry standard and up-to-date.



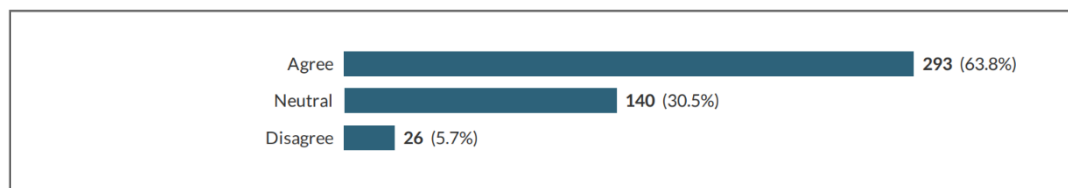
**Figure 2-2 Chart from INDEx report national level p. 65 (National Forum, 2020a, p. 65)**  
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Taking a data comparison from my institution’s report (see Figure 2-3) in comparison to the national report, 78% of students deemed “Digital skills are important in my chosen career” is comparable to 74% at national level. Their responses when questioned on “The software used on my course is industrial standard and up to date” 64% of students in my college compared better than 59% at national level. Notable data depicts 49% of students in my college compared to 46% nationally deemed their courses “prepares me for the digital workplace” (see Figure 2-3).

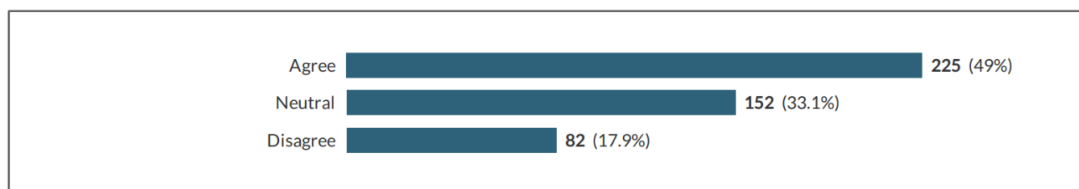
Digital skills are important in my chosen career



The software used on my course is industry standard and up-to-date



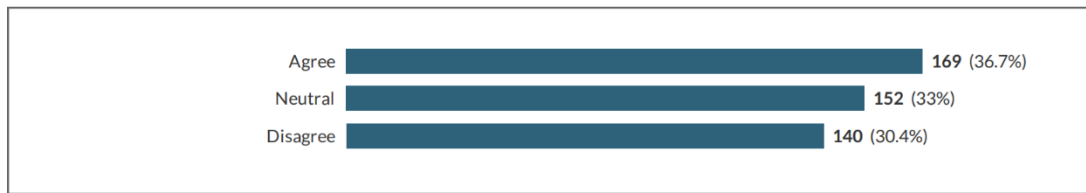
My course prepares me for the digital workplace



**Figure 2-3 INDEx survey charts at college level, p. 5. (National Forum, 2020b, p. 5) Image is licensed under a Creative Commons Attribution 4.0 International License**

The data of 49% saying “my course prepares me for the digital workplace” and worryingly only 37% of students who answered the survey in my college stated they had regular opportunities to update their digital skills (see Figure 2-4).

I have regular opportunities to review and update my digital skills



**Figure 2-4 INDEx survey charts at college level, p. 8. (National Forum, 2020b, p. 8) Image is licensed under a Creative Commons Attribution 4.0 International License**

These results from the INDEx survey stress the importance of ensuring our students are supported and encouraged to continuously upskill to keep up-to-date with digital innovation. The INDEx data aligns with results from the digital experience insights survey in the United Kingdom (U.K.), that showed “42% of higher education students feel their course prepares them for the digital workplace” (JISC, 2021b). The data that half of students deem their course prepared them for the digital workplace and 37% of students had an opportunity to review their digital skills drove my ambition to embed digital agility into the mindset of our students.

Students come with prior knowledge and experiences so, to this end, I looked at the education continuum (see Appendix 1), that influences digital use over a student’s education, from preschool (early childhood themes), primary school priorities and secondary schools (junior cycle and senior cycle key skills) to gain an understanding of my students’ prior education experiences. This allowed me to view common threads and to build on these themes, priorities, and skills to build on this continuum in my chatbot. As using the chatbot is voluntary and its use is dependent of students’ self-regulated learning and learning agility, it was important for me to have an understanding of both. The following section examines self-regulated learning before proceeding to examine learning agility.

## **2.4. Self-regulated learning**

Self-regulated learning (SRL) research brings attention to the importance for students in “goal setting, time management, learning strategies, self-evaluation, self-attributions, seeking help or information, and important self-motivational beliefs, such as self-efficacy and intrinsic task interest” (Zimmerman, 2002, p. 64). One model produced by Zimmerman (2000) submits a three-cycle model of

SRL focusing on forethought, performance and reflection. Forethought focuses on motivation of implementing planning tasks and goals. Once goals are achieved, the performance phase involves use of strategies to monitor progress of these goals and finally self-reflection involves the evaluation of how they got on (Zimmerman, 2000; Zimmerman, 2002). In the performance phase, it is important to be open to new effective strategies that take time to learn and not turn to outdated strategies (Zumbrunn et al., 2011). Monitoring, providing help and feedback, can guide new strategies to success (Ertmer & Newby, 1996; Zumbrunn et al., 2011). A student's efficacy, confidence and ability to complete tasks is influential in students' learning (Zimmerman, 2000). I contend this confidence and ability can be supported and augmented with the use of technology. In the performance and monitoring phase, meaningful tasks and intrinsic motivation is needed for students to engage (Zumbrunn et al., 2011). A student's meaningful perception of the task will motivate students to complete the assignment and use SRL strategies to achieve this (Ertmer & Newby, 1996; Zumbrunn et al., 2011).

Pintrich (2000) expanded on Zimmerman's model to propose four stages - forethought, monitoring, management and reflection (Pintrich, 2000). As these stages are not always in sequential order, the importance of cognition, but also motivation, behaviour, affective and context are also present in stages of self-regulated learning (Pintrich, 2000). Pintrich (2000) describes this process where learners are actively setting goals for learning and to achieve those goals they need to monitor, regulate and control their cognition, motivation, behaviour and context. Self-regulated students regulate their own learning by setting tasks to achieve goals, are responsible for their learning and their motivation to learn and are agile in changing their strategies dependant on the situation (Ertmer & Newby, 1996; Heikkilä & Lonka, 2006). This "motivational or affective" element is important for maintaining engagement on the task at hand even when there are distractions (Heikkilä & Lonka, 2006, p. 101). Vygotsky (1978) introduces the "zone of proximal developmental (ZPD)" concept as support to the instruction process; if you can break down a complex task and teach it in smaller chunks where each chunk is within the ZPD of the learner, this focuses the learner (Weibell, 2011). Interacting with my chatbot as 'a more



knowledgeable other' enabled students to take more tasks onboard through Vygotsky's ZPD (Weibell, 2011). The chatbot can assume the role as the more knowledgeable peer and create opportunities for multiple zones of proximal development.

Bruner (1978) drew on Vygotsky's work and introduced "scaffolding" with his hypothesis that any discipline can be taught with effective scaffolding.

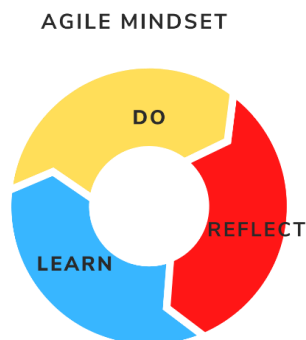
Scaffolding is an instructional technique which can be assisted with the use of technology. My students have different digital capabilities and they can use technology to help them attain the set of skills or knowledge they need to complete their tasks successfully. This involves designing solutions that build on prior knowledge and fosters their self-regulation by incorporating user thinking of where they are and what next step they need to take. The importance of just-in-time feedback and on-demand help is central to scaffolding. My technology space provides a constructivist approach that assists students' autonomy over the control, pace, sequence, and time that will scaffold their learning. It is important that learners can use the information in problem solving outside a school setting (Bruner, 1971). This emphasises the importance of context in learning in a guided setting and transferable knowledge. To this end, my communications with academic staff in this study allowed me to curate this context and transferable knowledge. As educators, we want to instil a learning culture that is agile, and our students embrace new ideas and are open to change.

## **2.5. Learning agility**

This agile learning culture is more pertinent within the evolving landscape of digital competencies. Peters and Romero (2019) call on universities not to neglect their role in "supporting and empowering student lifelong learning ecologies across multiple contexts and learning trajectories" (p. 1733). Their research on student engagement and strategies students use in formal and informal settings interplays with student motivation, student agency, self-regulation strategies and prior learning experiences (Peters & Romero, 2019). To assist in instilling this agile learning culture, SRL strategies and processes can provide positive outcomes to empower students' "life-wide learning" (Peters

& Romero, 2019, p. 1741). These different SRL processes for setting goals, adopting strategies, monitoring performance, restructuring plans, time management, evaluation and adapting are central to learning (Peters & Romero, 2019; Zimmerman, 1986; Zimmerman, 2002).

The do-reflect-learn cycle (see Figure 2-5), is at the core of being agile (Hayward, 2018, p. 34). This learning and adapting, learning from mistakes, getting feedback, ability to evolve in changing circumstances (Hayward, 2018) is pertinent for students to be digitally agile. Digital technology changes require students to adapt to new tools and situations and be agile learners.



**Figure 2-5 Agile mindset: do-reflect-learn**

Lombardo and Eichinger (2000) defined learning agility as “the willingness and ability to learn new competencies in order to perform under first-time, tough, or different conditions” (p. 323). How learners can adapt to the evolving digital landscape brought this concept to my attention. Speed and flexibility in learning is at the core of learning agility (DeRue et al., 2012). DeRue et al. (2012) gave emphasis to “individual’s goal orientation, cognitive ability, and Openness to Experience” (p. 265) as important to understanding how learners learn from experiences. This goal orientation to pursue learning is important in students’ self-regulation. Learners’ metacognitive ability allows them to transfer their learning and to be open to change and feedback in a changing digital landscape.

The importance of seeking feedback and reflection is central to learning from experience (DeRue et al., 2012). We do not often elicit feedback for perhaps fear of results, but taking feedback on board is important in the learning agile

concept. De Meuse et al. (2010) describe agile people as those who “continuously seek out new challenges, actively seek feedback from others to grow and develop, tend to self-reflect, and evaluate their experiences and draw practical conclusions” (p. 120). This is echoed by DeRue et al. (2012) who present digitally agile individuals as those who are open to experimentation, bringing richer learning experiences and then reflecting on these experiences in order to gain valuable learning insights. This will involve getting it wrong sometimes (De Meuse et al., 2010) and this failure needs to be embraced into a learning moment. This learning from mistakes when using software is invaluable as it provides learners with different insights, ideas and opportunities than if everything works perfectly, as this is not akin to real life practice. In our education systems, this embracing of mistakes and learning from them is not always visible and used and therefore can prevent an agile behaviour ethos. This study sought to gain an overview of the concept learning agility and did not look at any psychometric assessment of learning agility. I consider the connection between SRL and digital agility, incorporating the cycle of do-reflect-learn and learning from mistakes, which are discussed in the next chapter in the conceptual framework progression. Before preceding to this chapter, it is necessary to discuss the intervention of a chatbot, that I created to assist students’ learning journeys.

## **2.6. Chatbot overview**

The term chatbot is a combination of “chat” presenting conversation and “bot” for robot. This research is focusing on text-based conversation agents or pedagogical conversation agents when chatbots are used for education purposes (Hobert, 2019). Chatbots “are capable of interacting with the user using language-based interfaces” (Villegas-Ch et al., 2020, p. 2). Chatbots use natural language processing (NLP) to allow users to use every-day conversational language to ask questions and get automated results (Microsoft, 2021; Villegas-Ch et al., 2020). The Horizon Report 2021 produces samples of higher education use of bots, ranging from “Holly” at Durham University which guides students on administrative supports, “Chatsim” which helps language learning in the University of British Columbia and “Socrates” in the University of

Illinois Chicago which provides assistance to students using their learning environment Blackboard (EDUCAUSE, 2020). Bolton College in the UK built Ada, a campus digital assistant to help students with college and campus-related queries, for example timetable or examination queries (JISC, 2021a, 2022). This technology presently is in a collaboration pilot project with JISC to ascertain if can be adapted to be available to other higher education and further education colleges (JISC, 2021a, 2022). Georgia Institute of Technology in America in 2016 created Jill Watson, an Artificial Intelligent (AI) teaching assistant, built on the IBM Watson technology, to answer students' questions in a computer science class in knowledge-based artificial intelligence (Goel, 2016). This enabled students to witness AI in action in their module while also learning about AI (Goel, 2016). In the initial prototype, students wanted to nominate Jill Watson for an outstanding teaching award (Goel, 2016). Goel's vision is a future where all students will have access to AI to assist their learning (Goel, 2016).

To date, literature analysis outlines two categories of chatbot use in educational settings, administrative or service supports or teaching oriented (Hobert, 2019; Pérez et al., 2020; Winkler & Söllner, 2018; Wollny et al., 2021). Use of chatbots in learning is predominately in language learning, health and wellbeing interventions, and feedback and mentoring (Winkler & Söllner, 2018). Research presenting chatbots as a vehicle to foster language learning aligns with pedagogy of language learning through conversation or chat (Pérez et al., 2020). Chatbots can motivate users to play (Fryer et al., 2019), which is encouraging as play is important in learning (Vygotsky, 1978). Play allows learners to experiment and test themselves "under non-threatening conditions" (Fryer et al., 2019, p. 280). This role for chatbots inciting curiosity and facilitating play in a non-threatening environment can be leveraged to improve their digital agility. Fryer et al (2019) builds on Fryer's research collaborations with researchers since 2006, thus presenting a longitudinal lens into chatbots and language learning. Fryer et al. (2019) portray general interest in learning English and how a chatbot can potentially enhance "task interest" (p. 281) and "course interest" (p. 281). While this research is in the field of language learning, it could be translated to digital competencies and context specific

competencies, thus emphasising the importance of discipline involvement to drive digital agility in humanities disciplines. Our humanities students choose their discipline, hence there is the hope of “course interest”, so infusing digital tasks and agility at discipline level should motivate students to advance their digital agility.

Additionally, pedagogical roles or objectives for implementing chatbots in education are cited in the literature as skills improvement, tutoring, motivation, mentoring, efficiency, assessment and evaluating, and availability of education (Hobert, 2019; Winkler & Söllner, 2018; Wollny et al., 2021; Zawacki-Richter et al., 2019). From a pedagogical lens, “learning, assisting and mentoring” (Wollny et al., 2021, p. 12) are imperative and “all three roles are essential for learning and should therefore be incorporated in chatbots” (Wollny et al., 2021, p. 12). Central to this research is mentoring, learning and help assisting, with the aim to motivate students to use the chatbot to improve their skills. “Optic of chatbots” (Winkler & Söllner, 2018, p. 22), “content-awareness” (Winkler & Söllner, 2018, p. 22) and “guided by students” (Winkler & Söllner, 2018, p. 23) are additional elements to take into account in the construction process. Chatbots’ use in education should empower and allow students to regulate and control their learning (Winkler & Söllner, 2018). Literature brings attention to the “novelty effect” (Fryer et al., 2019; Pérez et al., 2020; Winkler & Söllner, 2018) and to counteract this novelty a “spaced use of technology” (Fryer et al., 2019, p. 286) was exhibited.

“Educators have just started to explore the potential pedagogical opportunities that AI [artificial intelligence] application afford for supporting learners during the student life cycle” (Zawacki-Richter et al., 2019, p. 2). Chatbots have the capabilities to answer user questions (Pereira et al., 2019). This can be leveraged in education to facilitate students to ask questions and to find immediate curated feedback. Students should see the chatbot as an “opportunity to learn-more (i.e., learn differently)” (Fryer et al., 2019, p. 286), and future chatbot developers should collaborate with educators to leverage this additional learning (Fryer et al., 2019). Chatbots can guide students through their learning journey and extend this learning beyond the classroom

boundaries (Kowald & Bruns, 2020). My aim is to increase students' digital agility by facilitating a twenty-four-hour seven-day-a-week 24/7 space where they can ask questions and receive immediate answers, find resources that align with their digital needs, and assists them to communicate with their peers on digital use and share information with their peers, i.e., learn-more and learn differently and extend their learning beyond their classroom experience. To this end, research has shown communication and collaboration with students will increase motivation and engagement with an activity when they provide inputs to their learning spaces (National Forum, 2020a; Toshalis & Nakkula, 2012). Giving students a voice, student agency and students as partners (Gravett et al., 2020; NStEP, 2021) is the resounding narrative from the National Forum (National Forum, 2014, 2015) and European Policy (European Commission, 2019), so giving our humanities students a voice and agency in the construction process aligns my research with this narrative.

I chose to use and develop a chatbot for three reasons. Firstly, from using *Microsoft Teams* since 2018 as a student learning space I have observed students' preference to use text-based chat instead of voice. Secondly, its immediacy of reply, and thirdly, I chose a chatbot as our students' widespread use of instant messaging (IM) can be leveraged to chatbot use that offers an anonymous and asynchronous virtual assistant service (Pereira et al., 2019). Chatbots at their core emulate everyday language, and can be deliberately designed to include social interaction (Bii et al., 2018). Jain et al (2018) study of first-time chatbot users points out that users preferred chatbots that are more human-like in their conversation language and systems that use familiar elements from other messaging systems. Their themes of "functionality, conversational intelligence, personality, and interface" (Jain et al., 2018, p. 899) aligns with findings from other studies (Bii et al., 2018; Brignell, nd; Microsoft, 2017). Their conclusions align with bot design best practice principles to be clear on what the bot can do, provide clear navigation, "handle dialog failure and end conversations gracefully" (Jain et al., 2018, p. 904). These insights on themes and principles were useful to take into consideration in my chatbot design.

## 2.7. Chatbot design

At the core of any software design success is usability (Nielsen, 1994; Shneiderman, 1985). Choosing familiar and user-friendly technology means there is less of a learning curve for students, and in turn incorporating the design elements of user-friendly, familiar interface, interaction, simplicity, flexibility, ease, immediacy, and ubiquity reinforces this usability. To provide comprehensive design guidance, Shneiderman's (1985) and Nielsen's (1994) research in interaction design crystallised my thinking. Shneiderman's Eight Golden Rules of Interface Design (1985) frames the foundation for any design:

1. Strive for consistency
2. Enable frequent users to use shortcuts
3. Offer informative feedback
4. Design dialog to yield closure
5. Offer simple error handling
6. Permit easy reversal of actions
7. Support internal locus of control
8. Reduce short-term memory load. (Shneiderman, 1985, para. 3)

Nielsen (1994) expanded on Shneiderman's rules and produced usability heuristics, to guide interaction design. Nielsen's ten general principles grounds my design:

- #1: Visibility of system status
- #2: Match between system and the real world
- #3: User control and freedom
- #4: Consistency and standards
- #5: Error prevention
- #6: Recognition rather than recall
- #7: Flexibility and efficiency of use
- #8: Aesthetic and minimalist design
- #9: Help users recognise, diagnose, and recover from error
- #10: Help and documentation. (Nielsen, 1994, para. 1)

While these “golden rules” (Shneiderman, 1985) and “rules of thumb” (Nielsen, 1994) are now thirty-seven and twenty-eight years old respectively, and from my research their sentiment holds true today and fosters and shapes the foundations of other design principles and guidance. The chatbot also provides a support service and hence the importance of the organisation in considering the user experience or learner experience in the design process (Gibbons, 2022). The learner experience is central to education (European Commission, 2020; HEA, 2017) and design plays a significant role in this experience (European Commission, 2020). Giving students or learners a voice to provide feedback on the design is central in building my chatbot.

The design of the chatbot is a significant contributing factor to students using it (Bisser, 2021). Building the chatbot’s personality by including the attributes of a name, a slogan and an image makes it more approachable to users (Bisser, 2021). To encourage students to use it, the chatbot needs to address students’ questions quicker and easier in comparison to another medium (Bisser, 2021). Research presenting principles of bot design encapsulates the importance of chatbots to be clear about their functions and not pretending to be human (Bisser, 2021; Brignell, nd). My chatbot used a simple text-based user interface so the ‘uncanny valley’ (Ciechanowski et al., 2019), where the bot is perceived as too close to being human and therefore becomes uncomfortable for the user does not apply. Furthermore, Ciechanowski et al. (2019) contend that users prefer a simple text-based interface than interacting with an avatar.

While a simple interface is preferred, it is however pertinent to give the chatbot a human and natural conversation that aligns with the personality, language and core values of the developer (Bisser, 2021). Detailed planning is important when designing the numerous conversation flows, taking into consideration the variety of different paths and triggers that activate the conversation user interface (CUI) (Bisser, 2021). The design of conversation strategies can enhance learning, provide guidance, build autonomy and promote exploration and encourage reflection (Kowald & Bruns, 2020). It is also important to take into account the target audience, their conversation habits and their requirement for an easy to use, navigable simple interface (Bisser, 2021). The importance of



user control, use of consistent language and standards, simple design and structured input, that is optimised for end users, echoes Shneiderman (1985) and Nielsen (1994). Microsoft reiterates this user experience as a priority in chatbot design (Microsoft, 2017). They contribute the importance of a chatbot to use a minimum of steps to provide an answer (Microsoft, 2017). By the same token, the chatbot should run on a variety of devices and platforms (Microsoft, 2017). The research above equipped me with insights to design my bot with student experience at its core. Additional research from Microsoft on building a “responsible bot” (2018) makes prominent the importance of articulating the purpose of the bot and being transparent on its functionalities. The bot should be “reliable”, “fair”, “respects user privacy” and “secure” and include “accessibility” (Microsoft, 2018).

The salient features echo design principles and heuristics above in user experience and feedback. “Citizen digital self-service” (ICS.AI, 2020) reiterates that user experience is a key to success. The questions that emerged from this research, for example “Is it easy to locate”, “does it provide useful hints”, “is it mobile friendly”, “does it deal with chit-chat” (ICS.AI, 2020) all granted me with thoughts to reflect on, in my chatbot design. Embedding a chatbot into the chat that students are already using in *Microsoft Teams* provides students with an easy to locate, mobile-friendly system that gave them agency to update their digital skills in line with their college work. In designing my chatbot it was also pertinent to consider learning design research.

## **2.8. Learning design**

Laurillard’s (2012) six “learning types” encourages reflection on what the learners are doing; this guided my design to scaffold students’ learning (Laurillard, 2012). This reflection, visualisation or storyboarding and focusing on learning activities, I saw as beneficial to guide my design. A similar active and interactive designing together learning approach using the steps - blueprinting, storyboarding, prototyping, testing, reviewing and adjusting was promoted by Gilly Salmon in her *Carpe Diem Teams Approach* (Salmon, 2016). This model actively promotes teamwork, especially between ‘knowledge owners’ - academics, learning technologists and librarians’ (Salmon, 2019). I saw the use

of a structural, iterative, revisionist approach but with the inclusion of a cyclical process as a benefit to my design process. This structural approach to design is evident in other models. The “ADDIE (analysis, design, development, implementation and evaluation) instructional design model provides a systematic approach for designing and developing a learning experience” (Khalil & Elkhider, 2016, p. 150). Conole’s (2015) design process guides the conceptualising of a learning intervention to trialling and evaluating it using active real-life learning interventions. “Central to this approach is the premise that people see teaching and learning differently” (Conole, 2015, p. 7); each educator brings to the design space a variety of beliefs on pedagogy and different competencies in technology (Conole, 2015). While I used an agile approach to my chatbot construction, these models brought forth reflection points.

Failings of software developments in the past have been attributed to the lack of communications with users and a linear structured approach to construction. This collaboration in putting users at the centre of the process is central to all project successes. Users are central in Universal Design for Learning (UDL) that focuses on the limitations of learning environments and not learners. These sets of principles and guidelines guide the design of learning environments that are accessible and effective for our learners (CAST, 2018). UDL is built on neuroscience research on the concept of multiple means of: 1. Representation, 2. Action and Expression and 3. Engagement (CAST, 2018). Technology can play a visceral role in implementing these multiple means. I took cognisance of learner variability by showing students the variety of technology functions available in *Microsoft 365* that they can adjust to align with their individual learning needs, for example live captioning or immersive reader. This empowers students to harness technology to align with their individual learning requirements and adjust their own environment to what works best for them. Self-regulated learning is central in the UDL framework empowering students to build skills and strategies to self-reflect and assess how best they learn, manage their learning and achieve their goals (CAST, 2018).

The areas examined in this chapter, namely the digital narrative, self-regulated learning, learning agility, chatbot design and learning design are influential to the student experience in using the chatbot. My research contribution is presented in section 1.8, namely a digital agility framework, design principles and an improved understanding of the needs of students for support in developing digital agility. The next chapter will build on this literature and present the framework I used to inform my chatbot.

### **3. Digital agility framework development**

My conceptual framework of digital agility embraces research in learning agility (De Meuse et al., 2010; DeRue et al., 2012), educational agility (Galés & Gallon, 2019), an agile mindset (Dweck, 2016), and digital frameworks at national and international level. This agile concept is supported by my theoretical framework of self-regulated learning (SRL) (Zimmerman, 2000; Zimmerman, 2002) as I propose that there is a strong alignment between the ability for students to self-regulate their learning and their self-regulation to continuously advance their digital agility. Technology can play a significant role in promoting the self-regulation process by providing a variety of functionality that can streamline and make self-regulation strategies more effective and efficient as presented in section 3.1 (Anthonysamy et al., 2020; Yot-Domínguez & Marcelo, 2017). Winkler and Söllner (2018) called for investigating “how self-efficacy and self-regulation skills can be increased by chatbots” (p. 28). Self-regulated learning (SRL) is central to students using my chatbot, as this is a learning space for all BA students to use voluntarily over their degree. This research will highlight how a chatbot can be used to call attention to, teach and promote self-regulated learning strategies that should assist learners to build self-regulated strategies in tandem to advancing digital capabilities. In addition, it will highlight students’ using the chatbot are triggering self-regulation processes in firstly recognising they have a gap in their digital knowledge and becoming motivated to seek the chatbot’s help to ask a question and find a solution. The chatbot can steer students in a path of discovery, reflection and learning (Kowald & Bruns, 2020).

As educators, we want to lead students towards the capacity for self-regulation and promote lifelong learning skills (Zimmerman, 2002). Educators and students need to be lifelong learners but also un-learners to keep current in this changing landscape and not keep a fixed mindset of using outdated methods of doing things (Sierra, 2005; Wheeler, 2019). As mentioned in section 2.2, unlearning and relearning are core to digital agility, and both unlearning and relearning involve a time commitment, a mindset and workflow change (Zumbrunn et al., 2011). Instead of committing time to new strategies, students

sometimes resort to using old, outdated practices that can be ineffective (Zumbrunn et al., 2011). I contend that the efficient use of technology can assist students in transforming their learning strategies in addition to being more time efficient. This use of outdated ineffective practices was noticed in my data and will be discussed later. This reinforces the narrative that students need to be agile and the interrelated concepts of SRL and digital and learning agility interplay in my conceptual framework.

Agility is a “mindset” that emerged from iterative, multiple developments of software working prototypes or solutions (Galés & Gallon, 2019; Hayward, 2018). For learning institutions to adopt an agile mindset, they need to change their institutional learning culture (Galés & Gallon, 2019; Hayward, 2018). Recent research from the European University Association (EUA) into “the role of strategy and organisational culture in promoting digitally enhanced learning and teaching (DELT)” (Andone et al., 2022, p. 3) reiterates this influence of mindset and culture on driving digital innovation. “An important aspect of change is that the institution needs to cultivate growth mindsets and create an organisational culture where new innovations and transformations can thrive” (Andone et al., 2022, p. 9). This is necessary to keep current in this changing digital landscape. This involves embracing failure and looking to the future and not the past to solve problems (Galés & Gallon, 2019) or fail fast and learn (Hayward, 2018). To build learning agility necessitates exposure to new learning opportunities, embracing feedback and curiosity to learn and fail and build and learn from these experiences (Hayward, 2018). I contend that this cycle of learning, do, perhaps fail and learn from failure (Hayward, 2018; Sierra, 2005; Wheeler, 2019) is important in our learning and needs to be supported (see Figure 3-1).

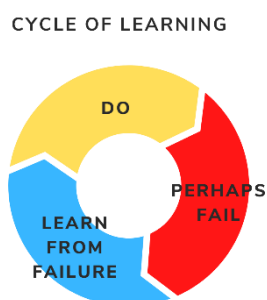


Figure 3-1 Cycle of learning: do, perhaps fail, learn from failure

I also propose that this agility can be fostered in students if academic staff have a shared vision of digital agility and with the incorporation of a digital agile spine across the degree programme. By this, I mean strategic digital agility could be infused in assignment work that can provide the capacity for innovation. Looking at our programme design and building the digital agility narrative across disciplines and intentionally planning this into students' learning experiences could foster students' creativity and ownership of their learning. Outside factors, for example national and international frameworks on digital competencies or literacies or skills, are also influential in establishing baseline students' digital requirements. These were included to add a comprehensive digital narrative into the conceptual framework. This conceptual framework is shown in Figure 3-8. The next section continues to take research in SRL forward from the literature review section 2.4.

### 3.1. Promoting self-regulated learning

Self-regulated learning theory provided useful multiple lenses in this study as illustrated in Figure 3-2.

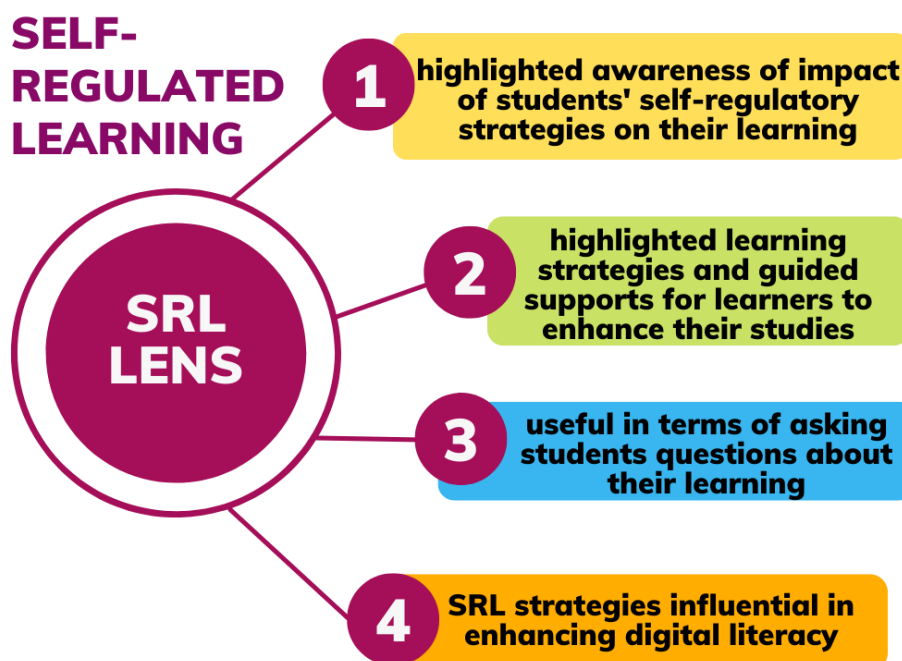
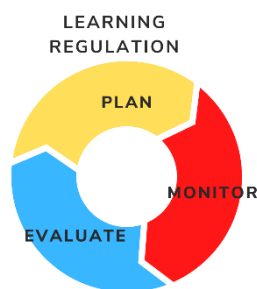


Figure 3-2 SRL lenses in this study

Firstly, it focuses the research activity on awareness of the impact of students' self-regulatory strategies on their learning. Self-regulated learners are more likely to do better academically (Zimmerman, 1986), and this self-regulation is important for lifelong learning (Zimmerman, 2002). Passey (2019) called for education systems to support self-regulation and this competence "being 'taught' or 'tutored' " (p. 5). Studies have shown that when SRL is supported, fostered, taught, promoted, modelled and implemented by teachers it leads to positive outcomes for students' SRL (Zimmerman, 1986; Zimmerman, 2002).

Secondly, the SRL lens helped to understand learning strategies and guided supports for learners to enhance their studies. The chatbot is designed to promote, assist, train, model and build awareness in students to use software for their self-regulation strategies, goal setting, planning, managing, organising tasks, help seeking, controlling their attention, self-monitoring and self-evaluation. It is important that students see the value in their learning tasks and acquire the self-efficiency, confidence and ability to complete these tasks which is influenced by their self-regulating capabilities (Zimmerman, 2002). Learning is governed by students' cognition, metacognition and motivation (Zimmerman, 1986; Zimmerman, 2000) and SRL incorporates these three components. Learners undertake tasks with a metacognitive knowledge about their abilities and what strategies they can use to complete the task (Ertmer & Newby, 1996; Quigley et al., 2018). This metacognition regulation of planning to work on the task, monitoring if the chosen strategy is working and finally evaluating the result in a continuous cyclical process (see Figure 3-3) of planning, monitoring and evaluating (Ertmer & Newby, 1996; Quigley et al., 2018).



**Figure 3-3 Learning regulation: plan, monitor, evaluate**

As educators, when setting learning tasks, we consider and facilitate students' learning journeys. Equally, as educators, the traits we want learners to present are proactive, self-awareness of strengths and weaknesses and having the ability to set goals and be self-motivated to achieve these goals and be successful, as proposed by Zimmerman (2002):

These learners are proactive in their efforts to learn because they are aware of their strengths and limitations and because they are guided by personally set goals and task-related strategies ... These learners monitor their behaviour in terms of their goals and self-reflect on their increasing effectiveness. This enhances their self-satisfaction and motivation to continue to improve their methods of learning. Because of their superior motivation and adaptive learning methods, self-regulated students are not only more likely to succeed academically but to view their futures optimistically. (Zimmerman, 2002, pp. 65-66)

Thirdly, it was useful in terms of asking students questions about their learning. Questions in my surveys delved into students' self-regulatory needs and learning management processes before, during and after their learning. Some students need to be made aware that learning is an activity they undertake themselves and they are not just passive recipients of learning (Zimmerman, 2000). Helping students to become aware of their regulatory capabilities and how they manage their learning should assist students in their learning journey and open their minds to cultivating processes that improve their learning. Empowering students to be self-aware of their learning needs, strengths and limitations will promote students' lifelong learning skills (Zimmerman, 2002). This involves "self-awareness, self-motivation, and behavioural skills" (Zimmerman, 2002, p. 66) that can be prompted by technology.

Finally, research has revealed self-regulation learning strategies influential in enhancing and shaping students' digital literacy (Anthonysamy et al., 2020; Greene et al., 2018; Peters & Romero, 2019). Motivating and guiding students to be independent learners is a core pursuit of the higher education sector (Yot-Domínguez & Marcelo, 2017). This progression to independent learners can be assisted in reinforcement of self-regulation strategies. The chatbot design seeks



to incorporate digital tools to promote students' SRL strategies and as this chatbot is available to students 24/7, this can provide help over all phases of SRL. In the forethought phase, for example, by triggering planning actions and prompting learners to set goals and presenting digital guidance could make this process more efficient and easier to monitor. The chatbot can guide learners in the performance phase to assist their self-control and self-monitoring, for example by bringing to the fore strategies to avoid distractions, controlling their attention and time management to aid learners to work toward their goals. The self-reflection phase can be promoted by asking questions that lead students to reflect on their learning, what worked for them, what difficulties they encountered and how they navigated these difficulties. Prompting students to manage their learning by using the software available to them in college, for example file management, or note taking, or group work collaboration features, can guide learners to be more efficient and effective in these processes.

I assert that use of self-regulation strategies is central to third level students' academic success and students must acquire these strategies, values and attitudes to handle changes and challenges over their degree. Infusing learning strategies into my chatbot, I hope to cultivate a curiosity for lifelong learning and advance students' digital agility.

### **3.2. Digital agility**

As stated in section 1.5, my definition of digital agility is the agency to use technology to create, design, communicate, collaborate and thrive in a changing digital landscape. My definition of digital agility embraces and incorporates other narratives presented in the literature, for example, digital capabilities, digital competencies, digital capital and digital agency, but I place the emphasis on 'agility' and students' ability to adapt, change, learn, perhaps unlearn and learn to adapt their digital use to keep up-to-date with the constantly changing digital landscape. It is important that students can react to unexpected change but also are proactive to meet upcoming needs. Curating students' awareness of apps that are available in their *Microsoft 365* apps and that aids their studies is central to embedding a digitally agile culture. The variety of apps available to use was a revelation to both students and staff as articulated in my findings.

Including the use of industrial standard tools helped to ensure that students felt digitally ready and able to use applications that are used in the workplace. Results from the student INDEX survey indicated that only half of students deemed their courses prepared them for after college (National Forum, 2020a). As educators, we need to act as role models and have a shared objective and use software that will help our students cultivate this agile mindset and keep up with new software developments and set high expectations to ensure our students have the strategies to deal with the changing digital landscape (Flavin, 2017; Pettersson, 2018). The chatbot includes links, videos and bite-size or micro learning guides, allowing students to study the material at their own pace and time. Academic staff across all disciplines can play a significant role by reminding and signposting students to supports available. There are numerous frameworks that present a variety of digital requirements for citizens and students that are elaborated below as these are influential in a digital agile narrative.

### **3.3. Digital frameworks**

Digital competencies and teaching and learning are situated as a central tenet in Irish higher education and this narrative was enforced by the establishment of a National Forum for enhancing teaching and learning (HEA, 2018; National Forum, 2015). Students' ability to communicate, collaborate, research and present their college work using the functionalities afforded by technology is an expectation of all educators. Students need encouragement to embrace agility. I researched the variety of digital competencies or literacies frameworks to capture a holistic understanding of their commonalities. Firstly, the competencies of students' prior learning across their educational continuum is put forward, and then frameworks at national, European and world levels are brought up. The analysis of these frameworks led me to build my conceptual framework synthesising the key underpinning themes.

### **3.3.1. Education continuum in Irish education system**

In Ireland, at senior cycle, student key skills are outlined as “critical and creative thinking, communicating, information processing, being personally effective, working with others” (NCCA, 2009). This builds on their junior cycle key skills of “managing information and thinking, being literate and being numerate, communicating, staying well, being creative, managing myself, working with others” (NCCA, 2015). These in turn build on the primary and early childhood priorities (see Appendix 1). This awareness of prior competencies is important for educators to consider and build on in the creation of learning activities. The recently published Digital Strategy for Schools to 2027 shows three pillars to embed digital technologies in the education ecosystem, in “teaching, learning and assessment”, “infrastructure and policy”, and “research and digital leadership” (Department of Education, 2022, pp. 16, 17). This strategy will be an influential driver in the education system our future students will attend and the continued chatbot development will take cognisance of technological advancement. The next section reports a map of digital skills that are required by students and staff in higher education in Ireland.

### **3.3.2. AllAboard digital skills in higher education**

The National Forum in Ireland project AllAboard used the analogue of a metro map to capture the multi-faceted range of capacities, competencies and practices both students and academics should acquire to navigate the digital landscape (AllAboard, 2015). Today some elements of this map (see Figure 3-4) could be merged with the pace of software and devices convergences, but this reinforces my digital agility necessary to evolve with this changing digital

landscape.

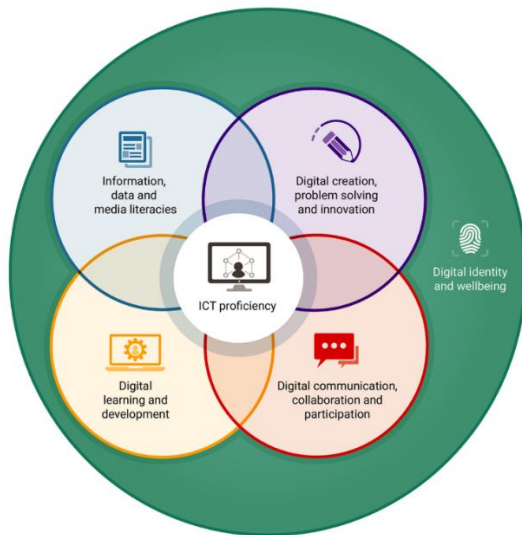


Figure 3-4 AllAboard digital skills in higher education (AllAboard, 2015) Image under a CC BY-NC 4.0 International licence and attributed to 'All Aboard'.

The map identifies digital skills for all those who study and work in the higher education sector and shows these skills as metro lines. The lines established are: “find and use, teach and learn, communicate and collaborate, create and innovate, tools and technologies, and identity and wellbeing” (AllAboard, 2015) showcasing the multitude of digital skills to promote the advancement of digital capacities in higher education. The map echoes different frameworks and builds on the digital capabilities work of the Joint Information Systems Committee (JISC) in the United Kingdom (UK) and elements of the European Framework for the Digital Competence of Educators (DigCompEdu) introduced below.

### 3.3.3. Jisc digital capabilities framework: The six elements

Jisc in the UK details “digital capability in six overlapping elements” from Jisc indicated in Figure 3-5. This inclusion is a useful exercise for the reader to compare similarities with other frameworks - communication and collaboration, identity and well-being, creation and innovation, learning and development, and tools and technologies (JISC, 2019).



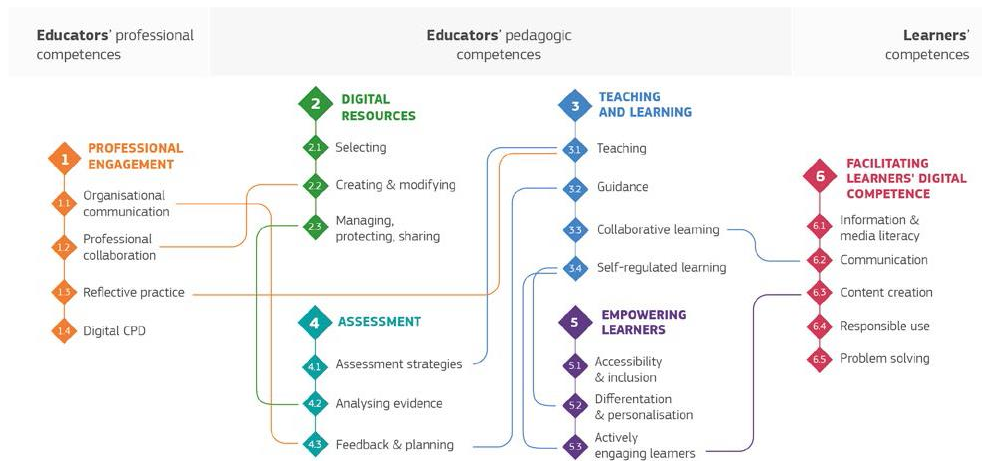
**Figure 3-5 Jisc digital capabilities framework: The six elements (JISC, 2019) Image is licensed under CC BY-NC-SA)**

These similarities are also evident in the European competence frameworks presented in the next section.

### **3.3.4. European Commission digital competence frameworks**

In 2013, the European Commission outlined a digital competence framework that included five areas of digital competence, “information, communication, content creation, safety, and problem solving” (Ferrari, 2013). This was updated in 2017 in the European Commission’s Digital Competence Framework, DigComp 2.0 to “information and data literacy, communication and collaboration, digital content creation, safety, and problem solving” (Carretero et al., 2017). This research expands proficiency levels of previous work to eight levels and provides detailed expectation of requirement to meet each level. This research was further updated in 2022 to DigiComp 2.2 to provide examples of each competence to promote interconnections and transversal skills (Vuorikari et al., 2022). Supplementarily, the European Union (EU) also released a DigiComp framework for educators. For this research the focus is on the section learners’ competences of “facilitating learners’ digital competence, information and media literacy, communication, content creation, responsible use and

problem solving” (Redecker, 2017, p. 8).



**Figure 3-6 The DigiCompEdu framework (Redecker, 2017, p. 8) Image is licenced under the Creative Commons Attribution 4.0 International (CC BY 4.0)**

Digital competencies of selecting, creating, modifying, managing and sharing are core areas in the figures above. Additional competencies to equip learners in communication, collaboration and promoting self-regulation and empowering learning are defined as core skills. This narrative continues in the next section, life competences 2020, that builds on the framework above.

### 3.3.5. Life Competences 2020

Life Competence 2020 (LifeComp) seeks to establish a conceptual framework incorporating key competence necessary for lifelong learning. This is a timely document for this research as it places “self-regulation, flexibility, communication, collaboration, growth mindset, critical thinking and managing learning” (Sala et al., 2020) as core competences needed for life.

Learning to learn - Growth Mindset - Belief in one’s and others’ potential to continuously learn and progress. Critical Thinking - Assessment of information and arguments to support reasoned conclusions and develop innovative solutions. Managing Learning - The planning, organising, monitoring and reviewing of one’s own learning. (Sala et al., 2020, p. 58)

The metaphor of the tree imparts connotations of dependency on an ecosystem, interdependency and growth (Sala et al., 2020) as represented in Figure 3-7.



**Figure 3-7 LifeComp tree of competences describes nine competences, organised in three areas: The “personal” area (P1, P2, P3), the “social” area (S1, S2, S3) and the “learning to learn” area (L1, L2, L3) Image ©EU 2020, creative commons (CC BY 4.0)**

Competencies of SRL strategies - communication, collaboration, critical thinking, growth mindset and management of learning - align with this research as core to developing digital agile learners. A worldwide view of digital agile research is briefly mentioned in the next section.

### 3.3.6. World Economic Forum and OECD learning compass 2030

Research from the World Economic Forum (WEF) outlines 8 digital life skills. Park (2016) argues digital skills are a core competence and a critical element in every national education framework. She goes on to challenge educators to use technology to “nurture students’ ability and confidence to excel both online and offline in a world where digital media is ubiquitous” (Park, 2016, para. 3). These core competences are built on in the Organisation for Economic Co-operation and Development’s (OECD) learning compass. The OECD sets out the aspirations for a framework for the future of learning across the entire curriculum (OECD, 2021). This framework places digital literacy and data

literacy as core foundational prerequisites in this curriculum (OECD, 2021). Embedding digital and data literacy resonates with this research in its vision to embed a common digital narrative across the humanities degree. A review of the frameworks above are addressed in the next section.

### **3.3.7. Reviewing common themes from frameworks**

From reviewing the frameworks above the common themes and overlapping important competencies are:

1. Information agility
2. Data agility
3. Communication agility
4. Collaboration agility
5. Creativity, design and innovative agility
6. Digital identity, safety and wellbeing management
7. Agility in critical thinking, evaluating and problem solving
8. Agility in management of learning and learning strategies

These competencies echo the foundational competencies students receive in the first year of their Bachelor of Arts (BA) degree as outlined in section 1.3. The formation of a conceptual framework for this research draws together the literature and digital frameworks to present a visual representation of my thought process. The next section communicates this diagram.



### 3.4. Framework development

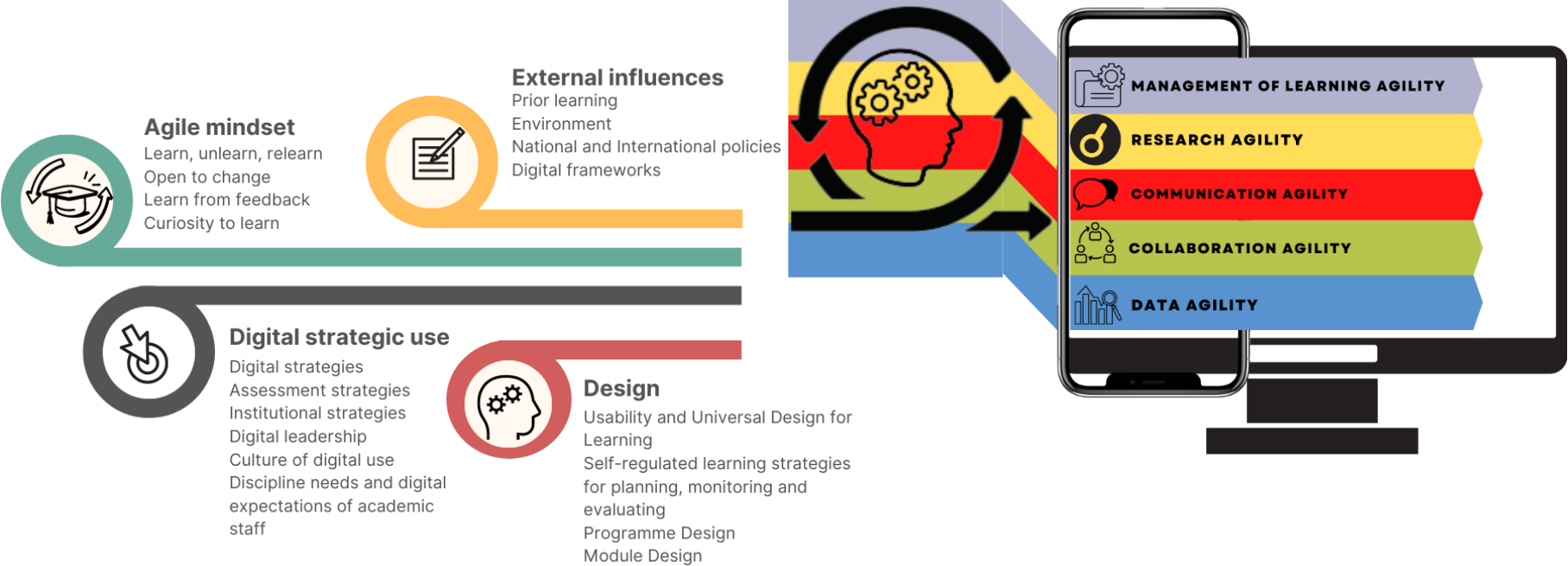


Figure 3-8 Framework development

My diagram places the learner at the centre; this is important as the learner is



the driver of their learning. This central graphic includes the symbol of agility which is represented by the arrows. These arrows symbolise that the process of learning is continuous and how learning needs change and is dependent on a variety of external influences that also change. The left side of my diagram states the influences that can impact digital agility. These influences also change over time. An agile mindset and learner ability to learn, unlearn and relearn, or do-reflect-learn is highlighted. Unlearning and the inclusion of an agile mindset is central to my concept as students need to be open to changes in technologies and have the ability and curiosity to embrace new technology and software. This development of lifelong learning skills and importantly to unlearn old methods is key to digital agility. For students to be aware of this lifelong learning cycle they need to be confident to self-regulate their learning. The SRL strategies or processes of the learner in forethought, performance and reflecting or planning, monitoring and evaluating are also influential in their learning. These strategies need to be incorporated in the design of learning aids to guide students to insights into how they learn best. Providing learners with choice on how they manage their learning environment to suit their specific needs gives students the autonomy to learn.

The right side of the diagram shows the many interrelated elements that interplay with learners' digital agile advancement. Notably, the inclusion of the agile symbol incorporating a person graphic and cog symbols denotes that these elements are constantly changing with environmental influences. These learners must be agile in managing their learning, be agile in using a variety of research tools, agile in communicating this research and collaborating with others using up-to-date technologies and agile in their use of data to present their research. To achieve this agility, learners must be open to unlearn old, outdated digital functions and relearn new up-to-date functions. As educators, we build students' awareness of their learning needs and become more self-regulated. Taking the right-hand themes from Figure 3-8, this represents my key digital agility competencies: management of learning agility, research agility,

communication agility, collaboration agility and data agility that are continuously changing as represented by the agile symbol and changing mindset symbols (see Figure 3-9). These digital agility competencies I am advocating embedding as a digital spine in the degree programme.

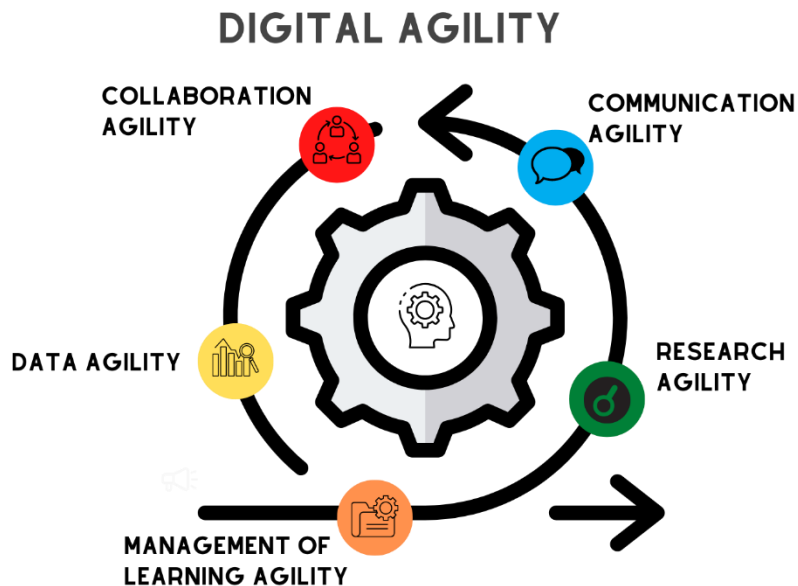


Figure 3-9 Digital agility framework

This research brings attention to the potential of a chatbot to scaffold these digital agile competencies. To assist this process, I used the literature to inform design principles, that directed the design and development of the chatbot environment, as well as the creation of learning resources. The next chapter will present the research approach used to develop the chatbot that seeks to scaffold students' digital agility.

## **4. Research approach: Design-based research (DBR)**

### **4.1. Introduction**

This chapter outlines the methodological approach in this study. It provides an overview of design-based research, the rationale for choosing this form of research and how it is presented in this study. Firstly, this chapter presents the research questions, then briefly describes the methodological considerations, the sample population and the data collection phase. It outlines the data analysis, quality and ethics considerations, followed by a detailed discussion of the design-based research process. Finally, a detail journaling of the design-based research phases is provided. The previous chapter outlined the development of a framework (one outcome from this research) that aligns with student and disciplinary digital requirement. To advance students' digital agility, a chatbot was built. The development of the chatbot, another outcome of this research, is discussed in section 4.6.2.2. The chatbot's development was underpinned by design principles (another outcome from this research) as discussed in section 4.6.2.1. As this research included a practical element, it was important to involve stakeholders in the research process. Student and academic staff voices were used to assist in the development and testing of the chatbot as presented in section 4.6.3. These voices provided answers to the research questions. As presented in chapter 1, specifically, the research questions sought to explore:

RQ1: How can a chatbot be designed and developed to support students' self-regulated learning of digital agility?

RQ1.1: What perceived benefits and limitations did students present in the design and development process?

RQ1.2: What digital questions were not anticipated and should be included in the chatbot knowledge base?

RQ2: What are the student's perceptions of the chatbot for supporting their digital agility?

RQ2.1: What factors will enable students' self-regulation?

RQ2.2: What factors will hinder students' self-regulation?

RQ3: What recommendations are there for designing and developing a chatbot to support students' digital agility?

To address the research questions, different research approaches are considered and discussed in the next section.

## **4.2. Consideration of possible research methodologies**

The study followed Creswell's (2014) exploratory mixed methods "gathering qualitative data to explore a phenomenon, and then collecting quantitative data to explain relationships found in the qualitative data" (p. 573) . "Mixed methods research designs are procedures for collecting, analysing, and "mixing" both quantitative and qualitative methods in a single study or a series of studies to understand a research problem" (Creswell, 2014, p. 565). This mixed methods approach provided the data to address my research questions. It was also a quantitative / qualitative approach that led to the consideration of the three methodological approaches, case study, action research and design-based research. In the initial research phase, a variety of research methodologies were examined and considered, before design-based research was selected as the best methodological approach to drive this research study. These methodologies were case study and action research and are outlined briefly in the next sections.

### **4.2.1. Case study methodology**

Case study is a focused study of a specific event in a period of time (Stake, 1995; Yin, 2003). This approach is preferred when researchers want to investigate "how" or "why" questions in a real-life environment (Yin, 2003). Stake (1995, p. 5) argues that "the case is a specific, a complex, functioning thing". In gathering sources of evidence to research this functioning thing, a variety of documents can be used. "Most commonly used in doing case studies [are]: documentation, archival records, interviews, direct observations,

participant-observation, and physical artefacts” (Yin, 2003, p. 101). This mix of data sources assist in the triangulation of findings which aligns with other methodologies. While a case study approach would have offered findings on the phenomena in a local real-world setting (Cohen et al., 2011), this research sought to design and develop a solution that initiates change and can be more generalised to the population (higher education students) and therefore the case study approach was ruled out as a possible methodology for these reasons.

#### **4.2.2. Action research methodology**

Action research was also considered as a potential methodology approach. It is a popular choice of methodology for teachers who are researching their own education setting with the aim to bring about change (Cohen et al., 2011). Action research was initially coined by Kurt Lewin in 1947 who combined action and research and revolutionised the way educators think about researching practice (Cohen et al., 2011). This duality of theory and practice or bridging the gap between practice and research is central to a balanced approach in education research (Cohen et al., 2011). In this research approach, participants reflect, examine a specific problem to solve in their own practice using a cyclical process of planning, acting on this plan, observing and evaluating and finally reflecting, and this feeds into the next cycle (Cohen et al., 2011). The stages can vary but the general sentiment stays the same:

1. Identifying a problem that needs to be solved:
2. Collect data and organise data:
3. Analyse and interpret the data:
4. Act on evidence that is presented in the data:
5. Evaluate and reflect on the results and, decide on next steps. (Ferrance, 2000)

These stages are echoed in other methodologies. Action research focuses on improving participants’ local practice (Cohen et al., 2011) and while this is one strand of this research, it does not incorporate the macro holistic approach required for this study. Therefore, action research was rejected.

### **4.3. Design-based research methodology**

These approaches have similarities to DBR, for example action research use of iterative cycles and real life practice. It also involves participants and seeks to bridge practice and theory. Similarly, case study seeks to find solutions to real problems and involves participants. Case study uses a variety of data sources and seeks to bridge practice and theory. Design-based research was chosen for this research as it incorporates all of the above elements, but importantly also includes the design and development of a solution, with a focus on design that can be replicated in other settings. Another contributing factor is both case study and action research do not really incorporate student or participant voice to the same extent as DBR. In addition, DBR's similarity with the software design process and design thinking approach was also influential in the decision to choose this methodology as the best fit for my research questions.

This methodology has identified challenges in the messiness of real-life research, the generation of large amounts of data and comparison across designs (Collins et al., 2004). Notwithstanding these challenges, the iterative improvements to design in a real education setting and documentation of the process dissipates these limitations. "A detailed design history of this kind allows research audiences to evaluate the credibility of design decisions, and the quality of lessons learned from the research" (Collins et al., 2004, p. 34). The next section introduces an overview of design-based research and this study's design history, decisions and lessons learned.

### **4.4. Design-based research (DBR) the chosen methodology**

Design-based research (DBR) (Brown, 1992; Collins, 1992) at its core is agile, encompassing do-reflect-learn iterations, whilst also incorporating feedback, that allows testing, changing and refining (Hayward, 2018). DBR encapsulates a research approach that provides iterative practical solutions to real world issues in tangent with theoretical and usable outputs (McKenney & Reeves, 2019). This systematic approach of linking theory and practice to investigate, design, develop, implement, test and evaluate allowed the researcher to work through the different questions on an incremental and iterative development. Wang and

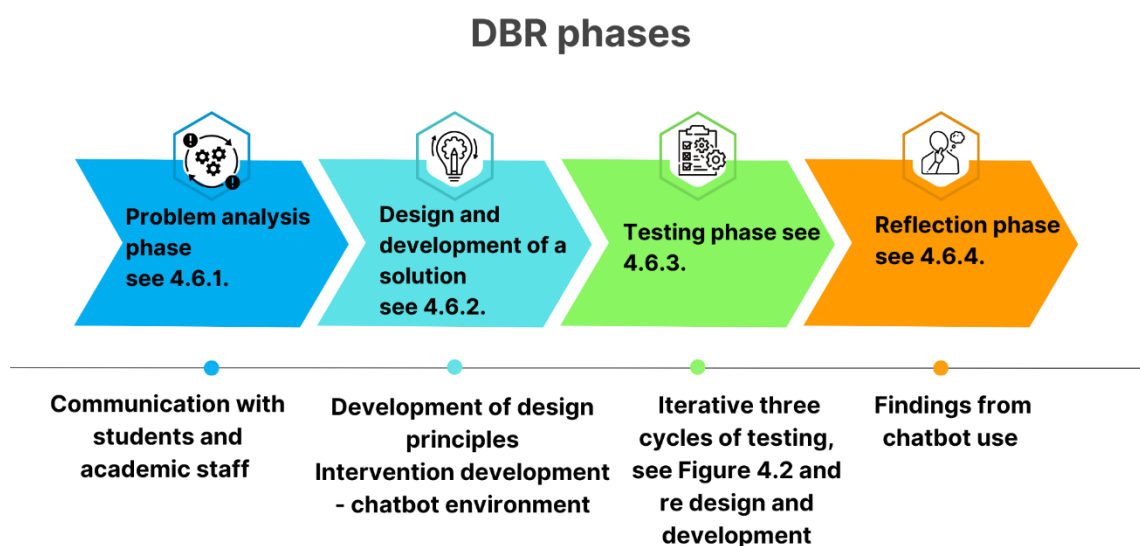
Hannafin (2005) impress the potential for the design-based research paradigm to advance “design, research and practice concurrently” (p. 5). They claim previous “design and research have evolved in largely a sequential manner, with little direct impact on practice” (Wang & Hannafin, 2005, p. 5). DBR portrays a dual role for the researcher as “both designers and researchers” (Wang & Hannafin, 2005, p. 6). Hall (2018) reports a “dual design dividend” (p. 28) and “DBR aims to synthesise practice and theory” (p. 38). This duality permits two lenses to analyse educational practice through “iterative analysis, design, development and implementation” (Wang & Hannafin, 2005, p. 6) in conjunction with user input into the process. This user voice is imperative as the chatbot is to help students, and without their input, cyclical testing, and feedback, I would have designed a chatbot that I thought my students needed rather than what they wanted! The findings demonstrate and echo the value of listening to and taking into consideration student voice so that students are co-creators in their learning.

DBR can “create and extend knowledge about developing, enacting and sustaining innovative learning environments” (The Design-Based Research Collective, 2003, p. 5). This approach is pragmatic, iterative, flexible and contextual (Wang & Hannafin, 2005) and evolves and unfolds through four phases (see Figure 4-1). Preliminary ideas involve analysis of the problem, then development of a solution, followed by a trial which involves iterative cycles of testing and refinement and finally evaluation of outcomes. These phases are named differently by different researchers, but in essence their meaning is the same. Looking at the research output through the lens of a “detective”, that focuses on evidence and rationale and “inventor” that looks for new innovative opportunities (McKenney & Reeves, 2019) guided my research. DBR outcomes are the practical intervention or the designed products, or tangible outputs or artefacts, and the theoretical design principles that aided in the intervention development and societal outputs (Edelson, 2002; McKenney & Reeves, 2019; Wang & Hannafin, 2005), such as professional development of people involved in the project as advocated by McKenney et al. (2006). This aligns with my epistemological approach to this research, and my desire to provide feedback to students who completed the survey and/or participated in the interview. This



feedback loop ensured the chatbot evolved with student input and they had access to new learning and skills. Moreover, the chatbot development is documented to direct professional development of academic staff or researchers interested in learning how the intervention was created, and the “reusability and replicability” (Hall, 2020, p. 160) of this approach with other student cohorts. The application and lessons learned is an important element of the research outcomes.

The design-based research approach enables the balancing of theory, practice and the development of tangible outputs that users (students and academic staff) can benefit from. Figure 4-1 provides a brief visualisation of the phases of this research project journey.



**Figure 4-1 DBR phases used in the research**

In Figure 4-1, the four phases, problem analysis, design and development, testing and finally reflection will be expanded on in later sections. The problem analysis phase is elaborated on in section 4.6.1 and then the development phase is uncovered in section 4.6.2. In addition, a detailed journaling of the process is incorporated in the discussion to specifically guide the replication of the chatbot development. The literature review facilitated the exploration of theoretical concepts and an investigation of issues underpinning the research problem (McKenney & Reeves, 2019). The next testing phase involving three

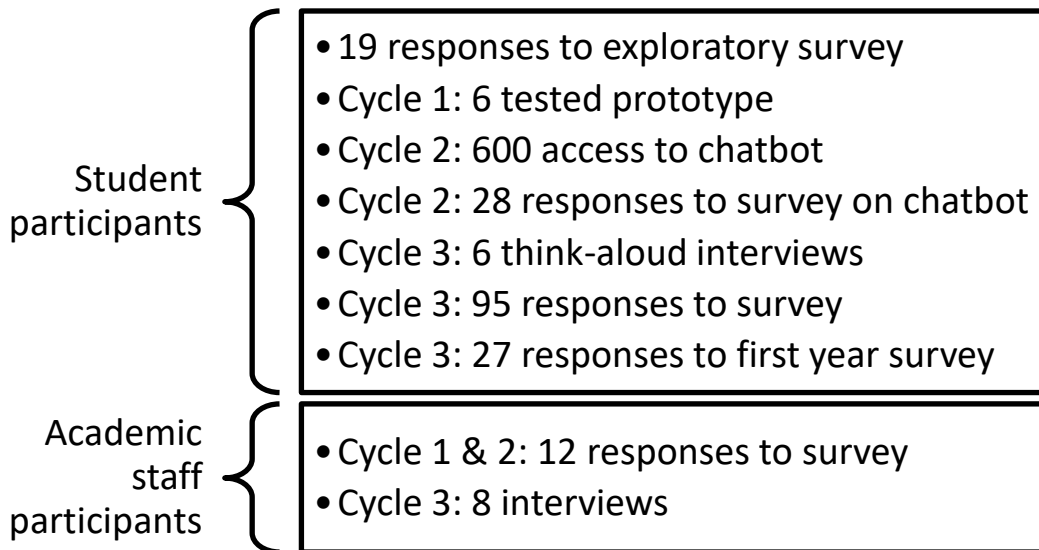
iterative cycles is outlined in section 4.6.3. The final reflection phase aligns with contemporary research and is discussed in section 4.6.4. Before exploring these phases, it is necessary to present details of the project research process, participants, insider research information, ethics, project management, data management, methods of data collection and methods of data analysis. The next section which details the research design describes this process.

## **4.5. Research design**

This section outlines the key considerations underpinning the research design that informs this study. It begins with participants, and then an insider researcher perspective is detailed. Next, ethics and ensuring quality and trustworthiness are outlined. Following this, project management, data management, methods of data collection and methods of data analysis are documented.

### **4.5.1. Participants in the research**

Participants in this research study are students and academic staff from a Faculty of Humanities in a College of Education and Humanities in Ireland. Each phase of the DBR process involved students and academic staff and the details of this input are presented as they occurred in each phase. The students are studying a four-year honours level, Bachelor of Arts programme. Students study four from thirteen disciplines in the first year and choose two disciplines to study to degree level. These disciplines are English Language and Literature, *Gaelige*, French Studies, German Studies, Geography, History, Mathematics, Psychology, Music, Philosophy, Theology and Religious Studies, Media and Communications Studies, and Drama and Theatre Studies and present the diversity of disciplinary digital competencies. Figure 4-2 provides an overview of participants, students and academic staff over the three cycles in the research design. A more detailed participant involvement is outlined in section 4.5.7.



**Figure 4-2 Summary of participant testing over three cycles**

The student participants from across different year cohorts were offered the opportunity to feed into, influence and shape the development of the research design, so that the chatbot aligned with their continuous digital needs. The second group of participants were academic staff. As a member of staff, I had easy access to participants. As became evident from my findings, academic staff communications and collaborations are influential in driving students' digital agility. The next section outlines my research position as an insider researcher.

#### **4.5.2. Insider researcher**

I drew on insights as an experienced insider with twenty years teaching on a humanities degree and working with students in developing their digital agility. This experience provides an “emic understanding about the problem” (McKenney & Reeves, 2019) and the challenges and difficulties students face to keep up with this changing landscape. This experience provides insights into the personas of students, the chatbot users (Bisser, 2021) and this prior knowledge greatly assisted in the chatbot creation. As a member of staff and insider, I was familiar with the institution’s technology provision and institutional policies that influence digital agility. As an insider researcher, I was able to tap into my personal relationship with students and colleagues, that an outsider

would not have access to. Insider status was important as participants were open to sharing digital requirements in their disciplines. The next section outlines other aspects of ethics in this research.

### **4.5.3. Ethics**

“Ethical considerations pervade the whole process of research” (Cohen et al., 2011, p. 83). This study was required to present to and was reviewed and approved by two research ethics committees, the researcher institution and Lancaster University. This confirmed it adhered to a set of protocols to ensure safety of participants. All survey and interview participants, students and staff completed a “Consent form” and read a “Participant Information Sheet” as required to adhere to ethical standards. Participants were made clear they were under no obligation to participate and could withdraw at any time with no need for explanation. No issues of informed consent, confidentiality or power issues emerged (Creswell, 2014). Students and staff used their agency in choosing to take part in this research by completing the surveys. For interviews, students and staff were asked if they would contribute to the study. A verbal explanation in addition to written explanation on informed consent, anonymity and the right to withdraw was imparted to interview participants. Interviews were conducted at mutually agreed times. Section 4.5.7 expands on the details on this data collection.

Ethical consideration on storage and management of data was approved by both ethics committees. Pseudonyms were used in all recording of data, hence data from the surveys was gathered anonymously using a number as a replacement for name. “Where this situation holds, a participant’s privacy is guaranteed, no matter how personal or sensitive the information is” (Cohen et al., 2011, p. 91). In comparison, participants agreeing to interviews cannot expect anonymity. “At most the interviewer can promise confidentiality” (Cohen et al., 2011, p. 91). Interviewee’s data were anonymised, and the importance of non-traceability duly considered. All data were stored in adherence to data protection and General Data Protection Regulation (GDPR) guidelines in the university’s security compliant cloud space. Adhering to protocol requirements

of two institutions assisted in ensuring that this research study met stringent ethical standards.

For ethical reasons, this chatbot is not linked to any specific module and students are making the choice themselves to use the chatbot when they have any digital questions. This chatbot is only to support students and thus does not present any ethical issues of links to student grades. In terms of relationships with participants and this research, I was on professional leave for the duration of the data gathering phase, and this avoided any power relations that may have emerged if I was personally teaching students. By not teaching any modules, students could be freer to not complete surveys or respond to volunteering requests to test the chatbot. To maintain ethical research, it is important that the researcher reveals the purpose of the research and procedures, and reporting accurately the findings is imperative to ensuring quality and trustworthiness of the research that is outlined in the next section.

#### **4.5.4. Ensuring quality and trustworthiness**

Triangulation of different data sources, surveys, interviews and document analysis can assist in ensuring validity and trustworthiness of education design research (Cohen et al., 2011; McKenney & Reeves, 2019; The Design-Based Research Collective, 2003). This quality is further ensured by the repetition of DBR cycles that bring more rigour to the quality of the findings (McKenney & Reeves, 2019; The Design-Based Research Collective, 2003). Data quality concerning “representativeness and trustworthiness of data” (McKenney & Reeves, 2019, p. 111) requires further elaboration and attention. For instance, how well does the data represent the voice of the stakeholders? And is each source used valid or trustworthy? (McKenney & Reeves, 2019). Lincoln and Guba (1985) depict qualitative validity criteria as:

- Credibility - participant can have confidence by member checking their interview notes.
- Transferability - the reader can judge the research from the detailed narrative of the research process.

- Dependability - if the study was replicated would it produce the same results.
- Confirmability - the findings are shaped by the participants and not the researcher agenda.

This chain of reasoning can lead to rigour in member checking, triangulation, completeness and align with findings from literature (Lincoln & Guba, 1985; McKenney & Reeves, 2019). This chain of reasoning is continued in the next section on project management. Management of research, management of data, project organisation and management, and effective use of software functionality is an important part of the research process.

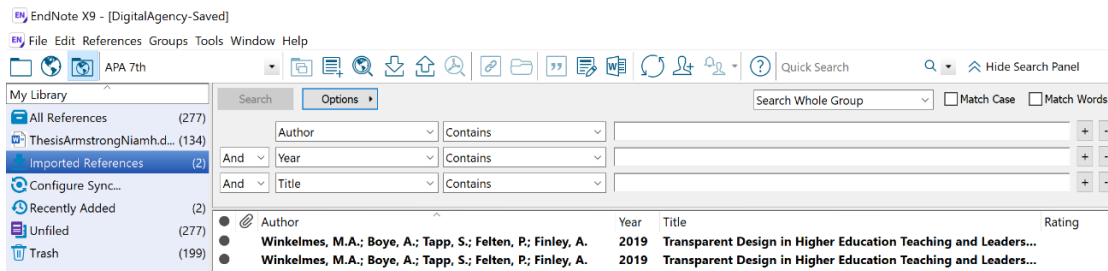
#### **4.5.5. Project management**

To manage the research study, inform my reflection and interrogate the data, I used *NVivo* as my document and coding management system. This computer assisted qualitative data analysis software (CAQDAS) assisted the organisation of all material and also provided an audit trail of data, coding and analytical processes whilst facilitating the control of all the data in one space. This audit trail provided rigour to the data and findings as it ensured all stages in my work were traceable and transparent (Bazeley, 2009). I used the reference management software *EndNote* to organise the literature review. This use of software to organise all elements of the research aligns with the digital agility story. One issue that affected the seamless workflow was some online publishers include the DOI address <https://doi.org/> with the DOI number in the fields section. Both were included in the import of data fields, causing *EndNote* to include the DOI twice in referencing the data output (see Figure 4-3). As this issue was only with some publishers, the removal unfortunately involved manually editing the DOI field for the reference in *EndNote*. Similarly, duplicate copies of the reference appear in the database of some publishers (see Figure 4-4), which again involves manual deleting. *EndNote* technical support provide an excellent service and have raised these issues to their development team. This feedback loop contributes to the digital narrative that as users of software we can be influential in driving software change. However, whilst reenforcing

the need to be agile software users, we also need to be aware that sometimes there are glitches.

Ciechanowski, L., Przegalinska, A., Magnuski, M., & Gloor, P. (2019). In the shades of the uncanny valley: An experimental study of human–chatbot interaction. *Future Generation Computer Systems*, 92, 539-548. <https://doi.org/https://doi.org/10.1016/j.future.2018.01.055>

**Figure 4-3 DOI duplication issue**



**Figure 4-4 Export citation duplication issue**

The *EndNote* data were exported as an Extensible Markup Language (XML) file and then imported into *NVivo*. This enabled me to store all journal articles and reports in one place and lever the software functionality to further interrogate the literature. I imported my survey data, secondary data from the national and college INDEX reports and my interview data into the software. This software delivered the functionality to cross-reference my literature with my data, thus providing structure and aided rigour to my analysis. The software yielded an audit trail of my thinking and the autogenerated features revealed the opportunity to cross check and correlate my themes and keywords. Interrogating the data or journal articles with auto coding, word frequency, maps, queries, and matrix coding gave scope to explore commonalities in the digital narrative and I used these insights to present themes. In order to keep up-to-date with the digital narrative on websites and social media platforms, I used *NCapture* for *NVivo*. This allowed me to capture conversations online and import as another data source that I sorted, coded and interrogated. Using *NVivo* software to project manage the literature and data allowed me to journal my research journey, and organise and analyse my survey and interview data. Using software effectively to organise academic research work is integral to a digital agile student's workflow. The functionality of cross-referencing and discourse analysis facilitates an efficient and effective workflow. Figure 4-5 displays an example of





compliant cloud space *Microsoft OneDrive*. This secure space uses dual factor authentication which means that in order to access these files two different steps are needed to verify permitted permissions. Data were stored anonymously to adhere to ethics as stated in section 4.5.3. To interrogate the data as revealed in the project management section above, these anonymous data were imported to *NVivo* that administrated the functionality to manage the data and organise it under different codes or headings. The next section describes the different methods used to collect the data.

#### 4.5.7. Methods of data collection

Table 1 displays an overview of how my data sources will provide evidence to address my research questions.

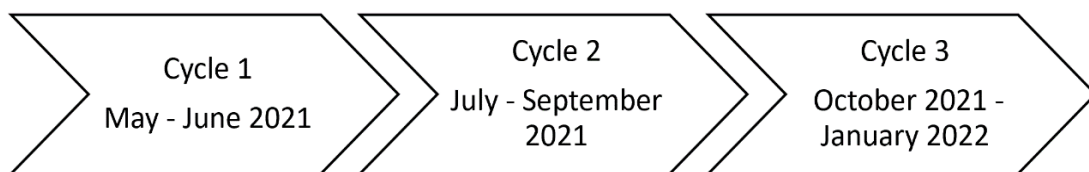
Research Questions (RQ)	Data sources
RQ1, RQ1.1 and RQ1.2	Literature review on chatbot design and development, academic surveys and interviews, student surveys and INDEX survey data and <i>Power Virtual Agents</i> (PVA) chat logs and usage statistics.
RQ2, RQ2.1 and RQ2.2	Literature review of SRL, student interviews and student surveys.
RQ3	Literature review of learning design and development, student interviews and PVA system analysis usage and chat logs.

**Table 1 Research questions aligned with data sources**

“In making choices, it is also preferable to employ several methods per question, as methods triangulation yields a more robust data set” (McKenney & Reeves, 2019, p. 106). In the initial exploratory or needs analysis phase, twenty-two random students chosen from the second year cohort were sent an exploratory survey, see Appendix 2, and nineteen students replied to this survey. The survey sought to explore the different technology students use in

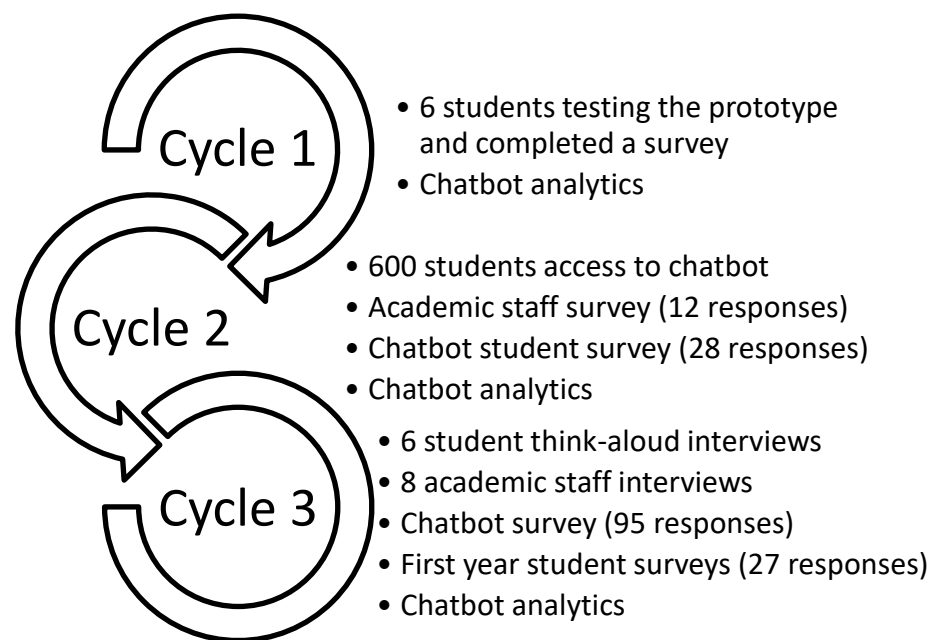
addition to questions on goals, planning and focus ability to ascertain self-regulation awareness. I purposely chose this second year cohort, as they were building upon modules they had completed in the first year. I was interested in exploring how students integrated knowledge and continue this best practice digital work in their second year. A few examples that emerged from my findings were data presentation, visualisation and analysis, guidance to record presentations and to present online. These findings are divulged in chapter 5.

Data collecting in DBR is undertaken in different cycles. This research collected data over a nine-month time frame in three cycles (see Figure 4-6).



**Figure 4-6** Timeline of each cycle

These three cycles of data collection, cycle 1 prototype cycle, cycle 2 and cycle 3 are illustrated in Figure 4-7.



**Figure 4-7** Data collecting in DBR cycles

In cycle 1, six students were asked to test my initial prototype and complete a survey with their findings. All surveys were created with the software *Microsoft Forms*, as previously mentioned, and students' surveys were anonymous. The six students were purposely chosen, two from second year, two third year and two in fourth year which is their final year of the Bachelor of Arts degree. The rationale for choosing students from different stages in their degree was to track and highlight different needs and requirements as they progress in their academic journey. At this stage, first year students were not asked to participate as this was their first semester in college, and they were only getting to grips with academic and digital requirements needed to be successful for their studies. I targeted students who I had taught in previous years as I knew they would provide rich insights and options on the prototype. While there was a gender balance of male and female, this study is not focussing on potential gender differences. This purposeful sampling induced an "information rich" (Creswell, 2014, p. 228) student voice to test the chatbot. This cycle also uses analytics of usage provided in the chatbot logs and this furnished additional data for findings.

In the next cycle, cycle 2, all Bachelor of Arts students in the college (six hundred students) were included on a team in *Microsoft Teams*. This *Microsoft Teams* space was established to host the chatbot, facilitate communication and notifications. To use the chatbot, students had to add the chatbot to their own *Microsoft Teams* chat space. This is a voluntary space that students can choose to go to to help with digital enquiries. In this *Microsoft Teams* space, students were free to complete a brief survey or poll posted to the conversation channel to input data on a variety of questions (see Appendix 2). Students had the option to unenroll from this space also. Hall (2020) refers to this cycle as mainstreaming and in this study this cycle involves "scaling up or mainstreaming the design" (p. 165). Students who used the chatbot could complete a survey to influence the chatbot creation and add their specific needs and requirements anonymously (see Appendix 2).

To gain a holistic perspective of digital requirements across the thirteen disciplines, academic staff from the Faculty of Arts were asked to complete a

survey about the digital requirements of their students. I emailed the one hundred and thirty staff members on a distribution mailing list of academic staff a survey (see Appendix 3) to ascertain the digital work they give to students, with a follow-up reminder with the intent to drive more replies. Twelve academic staff filled in the survey. Additionally, during cycle 2, the chatbot logs generated a record and statistical visualisation of chatbot use.

Hall (2020) refers to this final phase as capstone. In this cycle, a survey was administered to students to ascertain their mobile phone usage (see Appendix 4). To obtain a comprehensive live overview of students using the chatbot, in cycle 3, a second group of six students were randomly chosen from second, third and fourth year, as “information rich” (Creswell, 2014, p. 228) student voices to partake in a “think-aloud” (Nielsen, 2012) interview (see Appendix 5 for interview questions). Choosing a different group from the prototype group (cycle 1) conveyed additional students’ voices to test the chatbot.

Furthermore, to get a more comprehensive picture of academic staff expectations from different disciplines (Varga-Atkins, 2020), I interviewed eight academic staff. I purposely selected eight academic staff who were “information rich” (Creswell, 2014, p. 228). Interviewing academic staff was not initially planned but findings emerged from the initial staff survey that warranted further exploration (see Appendix 6). This adaptability of the researcher is an element of DBR methodology (Kennedy-Clarke, 2013). Five of these interviews were completed online using *Microsoft Teams*. Three staff preferred to be interviewed face-to-face, and these adhered to advised restrictions at all times. *Microsoft Teams* was used to record five of the online interviews and *Microsoft Stream* was used to host the recordings. *Microsoft Stream* software generates a transcript and this captions file (vtt, video text tracks) was downloaded and added to the *NVivo* project space for further analysis. During the face-to-face interviews, I took notes that later were transcribed, member checked and added to the *NVivo* project file.

To get a final snapshot of students’ digital needs, first year students were extended with an opportunity to input their needs and the one hundred and fifty first year students were sent a survey to get their feedback on if they used the

chatbot or not (see Appendix 7). A follow-up reminder was sent to drive more results. First year students were targeted this time as they had a semester of academic experience and therefore had insights into their digital needs which were worth capturing in this study. Second year students were surveyed in the initial review and to avoid survey fatigue were not asked to participate in this survey. Third year students were on off-campus placements and final year students were completing their undergraduate dissertations and were also not included in this phase.

Finally, chatbot logs were also collected in cycle 3 that showed visualisations of the chatbot usage patterns and user engagement logs. DBR offers the opportunity to refine the focus of the research and open a more nuanced understanding of the research problem (Kennedy-Clarke, 2013). The multi-methodological approach of data gathering and feedback from students and academic staff assists the validity and moderation of the research (Kennedy-Clarke, 2013). In addition, findings over three iterations present data “refinement, reflection and triangulation” (Kennedy-Clarke, 2013, p. 34) that leads to more robust outcomes.

The INDEx survey data were used as a secondary data source to align the findings with institution and national level data on students’ digital agility. This inclusion shows these findings at micro level, to present the position of institution level or meso level and then to findings at national level or macro level. These INDEx data were imported into *NVivo* for analysis. This inclusion of formatted interview transcripts, INDEx reports and literature opened opportunities for data analysis, that are presented in the next section.

#### **4.5.8. Methods of data analysis**

##### **4.5.8.1. Survey data**

“Typically, surveys gather data at a particular point in time with the intention of describing the nature of existing conditions” (Cohen et al., 2011, p. 256).

Surveying students and academic staff captured evidence of the state of art in digital use across the faculty. *Microsoft Forms* collated survey responses in real time and conveyed a visual representation of the answers. Individual responses

were analysed, coupled with a collation of all responses to display the data in chart or visual format. As a further analysis tool, the insights feature is triggered on the responses to any question that displayed any statistically significant data. These insights also illustrated a word cloud visualisation on the text-based data. For further analysis, the data were viewed in a spreadsheet format and prepared for analysis by removing or fixing any inconsistencies that may be in the data (McKenney & Reeves, 2019). This preparation step is important at the analysis stage as any potential errors, inconsistent formats, gaps or anomalies can lead to errors in the results. Once the data are arranged in a consistent format the full functionality of the software can be used to sort, analyse, pivot, and chart the data. The outcome of this analysis is set out in my findings chapters. The next section comments on data from interviews.

#### **4.5.8.2. Interview data**

To analyse interview data, I used reflective thematic analysis to identify the themes from my interview transcripts (Braun & Clarke, 2006, 2019) (see section 7.1). Whilst Braun and Clarke (2006) initially introduced a six-step analytical approach, their later work positions the importance of reflexive practice as a vital component to understand and unpack themes. They argued that “it is good practice to reflect on and identify what you’re assuming, and then interrogate whether those assumptions hold for any particular project” (Braun & Clarke, 2019, p. 595). While their initial phases have now changed, they afforded me with a start to think about the data. Clarke wants the researcher to avoid “searching for themes!” (Braun & Clarke, 2019; Clarke, 2021c). The question researchers need to ask is, do your theme names capture the story? (Clarke, 2021a). According to Clarke, this process is an individual’s own interpretive adventure (Clarke, 2021b). My interpretive adventure was assisted by managing my data in *NVivo* and using the tools the software provides for searching, classifying, sorting, filtering and coding, facilitating cross-checking themes and discourses that are present from transcripts and literature (see section 4.5.5). This reflective journey is further expanded on in section 4.6.4. The next section introduces the data from chatbot software.

#### **4.5.8.3. Chatbot analytics**

The chat logs were recorded and stored in the project's secure file storage space. The logs were downloaded every week and added to a spreadsheet file. As previously said, these data had to be prepared and cleaned, which means removing any errors, inconsistencies or anomalies before the data can be organised, sorted and pivoted with the view to drill into the data and get insights into the chatbot usage.

There is no option in the developer environment to download the analytics of the summary of usage or the option to save this snapshot as an image file format. To keep a record of these data, it was necessary to take a screenshot for each monthly period and paste this screenshot into a *Word* file. While this was a clunky way to record these visual data, recording these visuals allowed the analysis and comparison of a picture of software usage over the semester. The findings present examples of these chat logs and summary visualisations. The next section portrays the INDEx data that provides data at individual college level and a national snapshot.

#### **4.5.8.4. INDEx data**

The national INDEx finding report is available on the national forum website <https://www.teachingandlearning.ie/index/>. The report at institutional level was sent to institutional technology enhanced learning management and I requested a copy for analysis. These documents are submitted in pdf format, with text, numerical and graphic description presenting a snapshot of state of play of digital usage in higher education in Ireland in November 2019. Colleges were not furnished with the raw INDEx data only the data reported on INDEx reports. To analyse and compare these findings, both reports were read and reread, notes were taken and comparisons and differences in the national and institutional data noted. To analyse data in the reports, similar to the analysis of interview data, reflective thematic analysis was used to identify the themes (Braun & Clarke, 2006, 2019). Again I was aware of Clarke's (2021a) advice of using theme names to capture the story and the individual's own interpretive adventure (Clarke, 2021b) to present this story. It was imperative to capture the digital discourse from these reports to tell the story as these reports represent

reflections from students on their digital use, requirements and aspirations for digital use in their higher education studies in Ireland. A spreadsheet was created to input the numbers collated in both reports into one file in order to create charts to present a visualisation of the figures at national and institution level side by side for comparisons. Section 6.1 exhibits these findings. Supplementarily, the reports were added to *NVivo* for further insights. The next section outlines problem analysis, design, testing and review, the four phases in the DBR approach, illustrated in Figure 4-1 in section 4.4.

#### **4.6. Design-based research procedures or phases**

##### **4.6.1. Problem analysis phase – analysis and exploration phase**

This analysis stage began in the literature review that explores a variety of research to understand the problem, the context, the interrelating topics that influence and can shape the research (McKenney & Reeves, 2019). My initial problem analysis phase or “analysis and exploration” (McKenney & Reeves, 2019) phase explored what is the problem with the current situation and desired outcomes in communication with “practitioners” (Reeves, 2006). In this study, my practitioners are students and academic staff as stated in section 4.5.1. “It requires collaboration among a range of actors connected to the problem at hand” (McKenney & Reeves, 2019, p. 14). The problem in my case was the nonexistence of digital supports for the majority of BA students after their first year. Developing students’ digital agility is central to this research study, and therefore it is important that students were involved in this phase to ascertain the full extent of the problem, and also to confirm that it was not only my interpretation as the researcher and academic. “Early involvement can help foster shared ownership of the solution” (McKenney & Reeves, 2019, p. 91). Conjointly to this student voice at this initial phase, I also included academic staff who expect students to present their academic work digitally in a professional designed manner. This places academic staff as indirect stakeholders as the artefact is not designed for their use, but for their discipline digital requirements. Therefore, it was important to involve academic staff in the design process. Collaboration with users/stakeholders early in the process to teasing out the problem and design options shaped the understanding of the



problem from different perspectives (McKenney & Reeves, 2019). My focus was to demonstrate how a technological innovation could be designed and implemented to enhance students' capacity for digital understanding. The next section outlines the design and development of the chatbot.

#### **4.6.2. My solution design and development – design phase**

In this design phase, based on findings from the problem analysis, the solution design and development or “design and construction” (McKenney & Reeves, 2019) phase, involved designing and developing a solution or intervention. This solution was informed by innovations in technology and existing design heuristics and principles. These core elements of design delineated the path of my design process. I explored the feasibility of different solutions. For example, Dr David Kellerman, in the University of New South Wales in Sydney, Australia created a *Question bot* to answer questions on course work in his engineering modules (Kellermann, 2019). I had hoped to use this code but after meeting with my IT services management allowing this code on our tenant (the space that stores all the software available for college personnel to use) was not an option. I considered and eliminated *Facebook Messenger*, *WhatsApp*, *WeChat*, *Telegram* and *Dialogflow* options for chatbot development as these also present IT administrative interventions. After extensive follow-up research into what technology solution was available on site without the need for additional permissions or IT service assistance for my planned intervention, I chose *Microsoft Power Virtual Agents* as a user interface to “develop powerful technological tools and curricular interventions” (Barab, 2014, p. 164). This is a pragmatic choice for the developer environment, and I am not attributing any advantage over other chatbot environments mentioned above. The key focus is how technology can assist to foster student digital capabilities with pedagogical requirements always to the fore. To put digital agility into practice, I had to learn how to design and develop a chatbot from scratch and research a variety of design principles below to inform the application's design. The next section reports my draft design principles that were critical to keep in mind while the chatbot was being developed.

#### 4.6.2.1. Design Principles

Consulting the literature, I found relevant theories, principles and heuristics to guide my thinking, and research design principles that other researchers have published. The chatbot was designed to be a voluntary space for students to ask questions and search curated content that provided students with a digital spine over their BA. In the design, I used the lens of SRL and learning design principles. This mapping theory to practice is central to DBR (Wang & Hannafin, 2005). Involving students in ascertaining specific digital needs contributed to the knowledge base and development of the chatbot. Designing and developing my chatbot in line with the draft principles catapulted my chatbot's implementation.

**Principle 1:** Design is enhanced when users or stakeholders, the interest powered participants are present in the development and have a shared purpose (McKenney & Reeves, 2019; Mizuko et al., 2013).

**Principle 2:** The chatbot design should present a personality that reflects the culture, language, ethos and values to users (Bisser, 2021; Microsoft, 2017).

**Principle 3:** The initial introduction message is important, including a statement of abilities of the chatbot, clarity about the chatbot functions and what the chatbot can reply to (Bisser, 2021; Brignell, nd; Jain et al., 2018; Microsoft, 2017).

**Principle 4:** Importance of designing the numerous conversation flows brings learners along a variety of paths depending on their keywords or trigger phrases (Bisser, 2021; Microsoft, 2021).

**Principle 5:** Support material includes clear objectives to delineate learners' pathways by gaining attention, stimuli, including different levels of assistance and feedback (Gagné, 1985; Salmon, 2016).

**Principle 6:** Design of learning activities is enhanced when a combination of a structured and iterative approach of reflection, visualisation, prototyping, testing, reviewing and adjusting is used (Laurillard, 2012; Salmon, 2016).

**Principle 7:** Learning should include integration of existing and new real-world problems and incorporate learning strategies to enhance the learning experience, build self-confidence and promote development of lifelong learning (Gagné, 1985; Merrill, 2002; Zimmerman, 2002).

**Principle 8:** The importance of user control (Bisser, 2021; Microsoft, 2017; Nielsen, 1994; Shneiderman, 1985; W3C, 2021)

**Principle 9:** Design for accessibility and incorporate concept of multiple means that align with Universal Design for Learning (UDL) principles of : 1. Representation, 2. Action and Expression, and 3. Engagement (CAST, 2018).

1. The representation principle advocates to provide flexible, alternative ways to display content, audio, visual and language used in learning with the final goal that students can construct meaning and build on this (CAST, 2018; Rose, Gravel & Gorden, 2014).

2. Action and Expression promotes learners differ in how they can navigate a learning environment and express what they know. This includes considering the physical action to include assistive technologies. The Expression and Communication guideline advocates for multiple media, and finally the goal Executive Functions that they do their own planning and setting of personal goals (CAST, 2018; Rose, Gravel & Gorden, 2014).

3. Engagement brings into focus that no one means of engagement is suitable for all students, and as educators we need to bring learners along a journey from initially recruiting interest, to sustaining effort and persistence to the final goal of self-regulation (CAST, 2018; Rose, Gravel & Gorden, 2014).

**Principle 10:** Clear and consistent language and standards (Bisser, 2021; Microsoft, 2017; Nielsen, 1994; Shneiderman, 1985).

**Principle 11:** Simple design and structured input and optimised for end users (Bisser, 2021; Microsoft, 2017; Nielsen, 1994; Shneiderman, 1985).

**Principle 12:** It is important that the chatbot can run on a variety of devices (Microsoft, 2017; W3C, 2021).

**Principle 13:** Incorporate handling dialogue failure and end conversations gracefully (Brignell, nd; Jain et al., 2018; Microsoft, 2017, 2018; Nielsen, 1994; Shneiderman, 1985).

These principles guided and informed my approach to chatbot development. The next section documents in brief my chatbot development (for more information, see Appendix 8).

#### 4.6.2.2. Chatbot development - Intervention

For my chatbot development environment I used *Microsoft Power Virtual Agents* (PVA) for *Teams*. The chatbot name DigiHelp, introduction phrase and robot-like image was an important consideration to make the chatbot appealing to users (Bisser, 2021). The application programming interface (API) provisioned by PVA includes built-in natural language capabilities (Microsoft, 2021). The software's graphical interface afforded the environment to build topics to answer student questions based on trigger phrases and provided the interface to design the output presented to users (see Figure 4-8). Knowledge of your audience and awareness of the different questions they may ask is essential to designing topics.

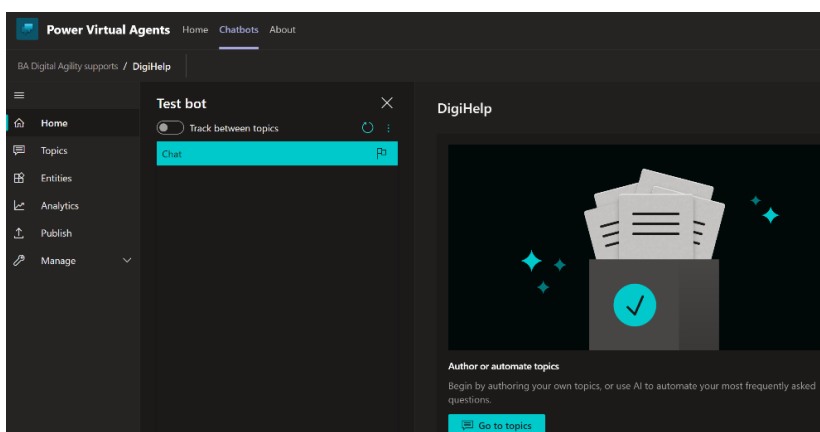
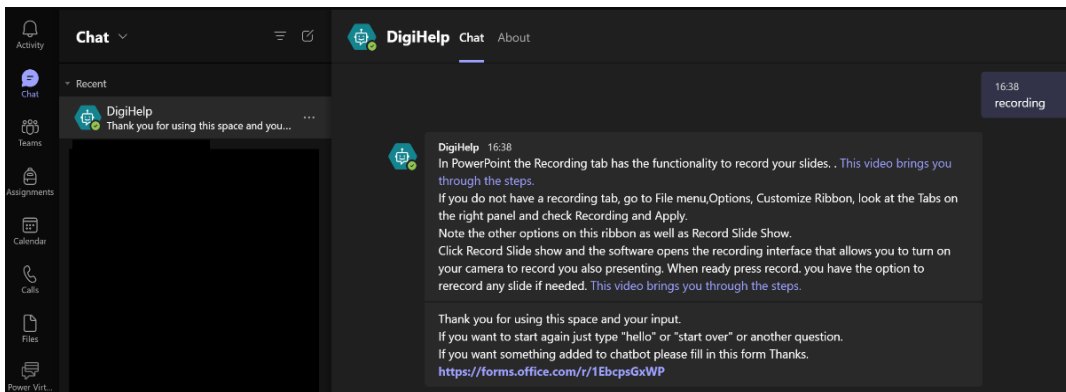


Figure 4-8 Power Virtual Agents developer environment

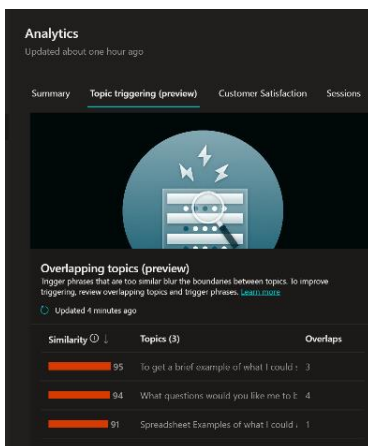
Students access the chatbot through the use of *Microsoft Teams* application that they are familiar with using from different modules that started to use *Microsoft Teams* over the pandemic. The chatbot is a simple chat-based interface that

students could add to their *Microsoft Teams* chat space and hence is available to students any time (see Figure 4-9).



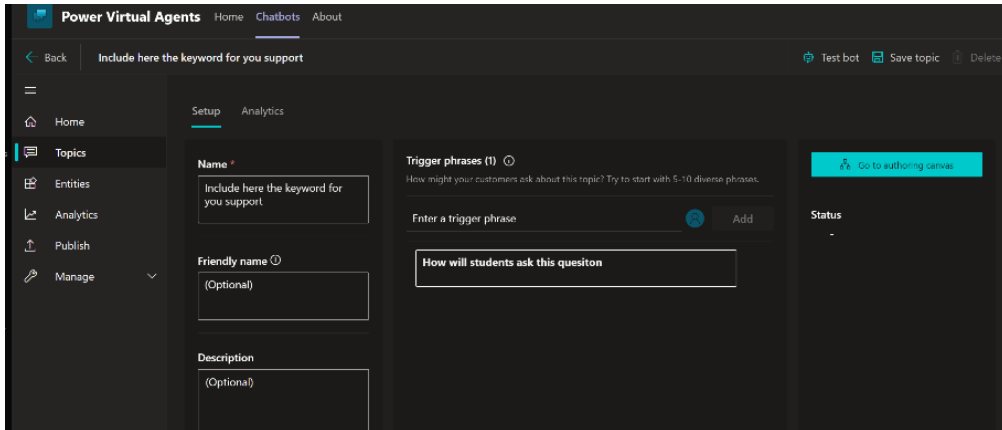
**Figure 4-9 Chat space on Teams with DigiHelp the chatbot**

In my initial, design five broad topics were included, for example: writing an essay or designing a form, to give my testers a preview of what the software could present. However, I discovered from overlapping topic analytics (see Figure 4-10) this was not the best approach as topics should be small individual conversations on a specific subject and represent the paths a user can be taken on when using the chatbot.

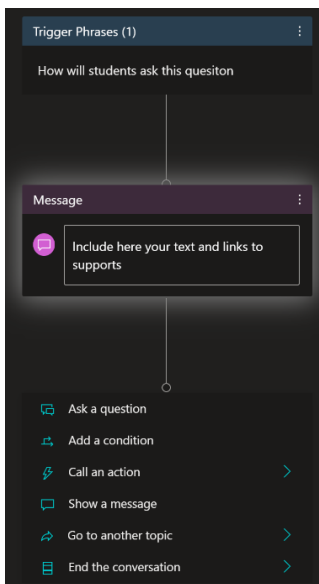


**Figure 4-10 Topic triggered analytics**

Topics consist of two primary elements or authoring components: trigger phrases (see Figure 4-11) and dialogue or conversational nodes (see Figure 4-12). Planning what trigger phrases students may use for questions and then planning the conversation path by choosing the conversation node (for example including a message node to insert text and a link to a designed video) is an important part of the user experience.

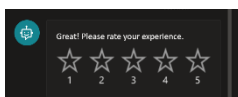


**Figure 4-11 Topic initial development interface designing trigger phrases**



**Figure 4-12 Topic development interface conversation path**

After the message, I needed to design the direction of the conversation by choosing another node, a message, asking a question or directing the conversation to another topic. In the initial design I used the “End the conversation” node supplied by the software, but this was linked to “rate your experience” (see Figure 4-13) and I subsequently changed it in other iterations.



**Figure 4-13 End of conversation rate your experience**

This environment authoring canvas had a built-in test space that allowed the testing of each topic in real-time and making any edits. As an educator, it was important to document this process and create a usable output to assist other

educators in this journey as documented in Appendix 8. The chatbot can foster the development of metacognitive processes and promote technology to manage, plan and assist learning (Anthonysamy et al., 2020). In prompting students, by using notifications on digital tools available for their assignments, this cultivates the growth of a digital agile learner. My next section imparts the chatbot in use and the testing process.

### 4.6.3. Testing phase - solution in use and testing

In this testing phase, to ascertain if the design was successful, my “evaluation and reflection” (McKenney & Reeves, 2019) phase involved iterative cycles of testing and refinement of the chatbot features. The prototype disclosed feedback on the chatbot and continuous testing to ascertain its use, “with ongoing practice the intervention is adopted, enacted and implemented” (Shattuck & Anderson, 2013, p. 188).

#### 4.6.3.1. Prototype testing

As outlined in section 4.5.7, six students were asked to test the initial chatbot prototype. These students were enrolled on a *Microsoft Team* and the link placed in the conversation area to allow students to click the link to add the chatbot to their chat space in *Microsoft Teams* (see Figure 4-14).

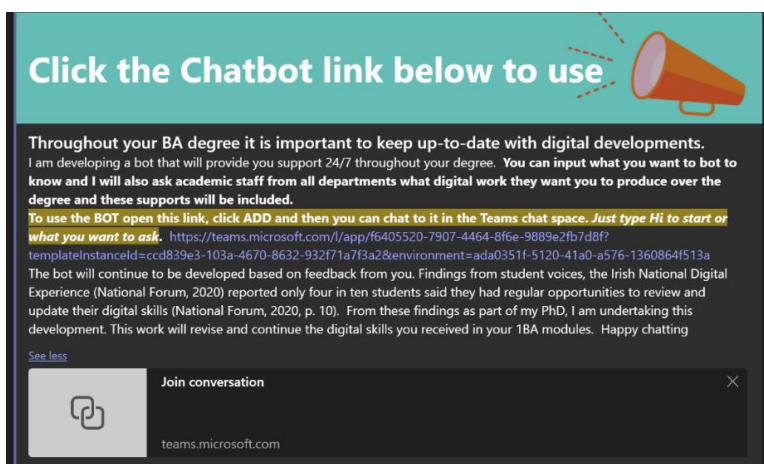
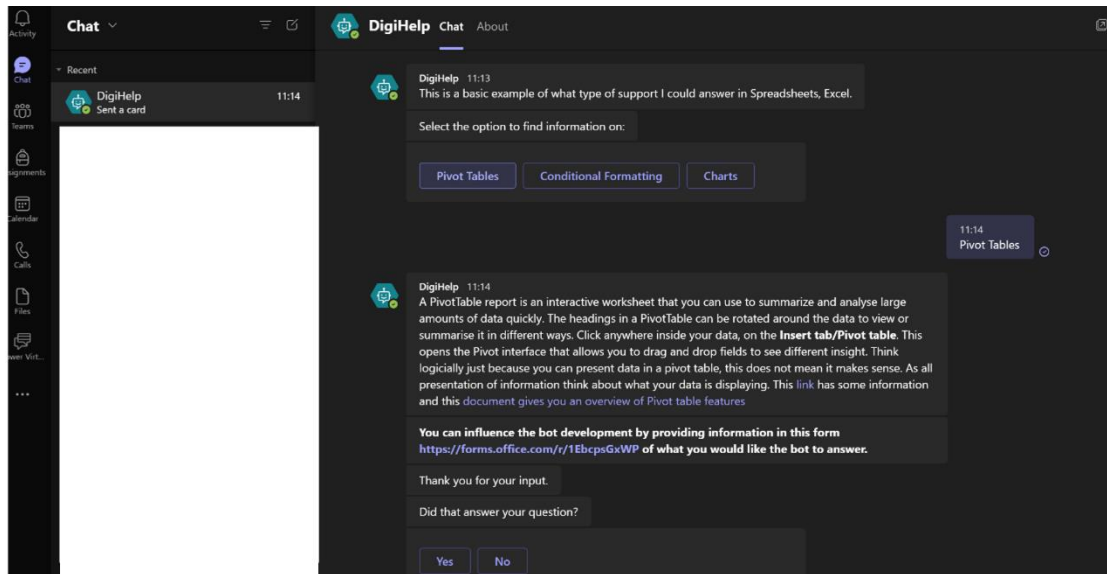


Figure 4-14 Chatbot setup on Microsoft Teams

Clicking the link opened the chatbot DigiHelp in their chat space on *Microsoft Teams*, a space that students were familiar with using (see Figure 4-15).



**Figure 4-15 DigiHelp in student chat space in Microsoft Teams**

The six students provided valuable feedback and this led to further analysis, exploration, design and development. The findings from this initial prototype testing are disclosed in chapter 5. After future analysis, exploration, redesign and development, then I enrolled all BA students onto the *Microsoft Team* that hosts the chatbot in preparation for the next semester.

#### **4.6.3.2. All BA students testing the support space**

An explanation of the chatbot with the opportunity for students to feed into the creation by inputting their suggestions in a survey was provided to all students (see Figure 4-16). This survey was anonymous, and it was the same survey which was designed for initial exploration (see Appendix 2), with one amendment: the question “what supports would you use, if available?” was removed. Feedback from this survey, in addition to the insights from academic staff, were added to the next iteration of my chatbot.



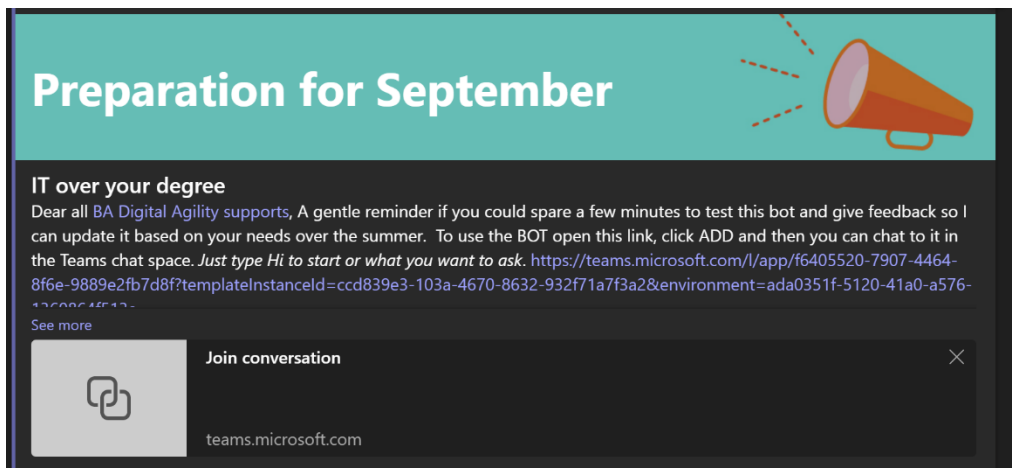


Figure 4-16 Ongoing development process

As a result of valuable feedback from one student, I included an instructional video to guide students to start using the chatbot, if required (see Figure 4-17).

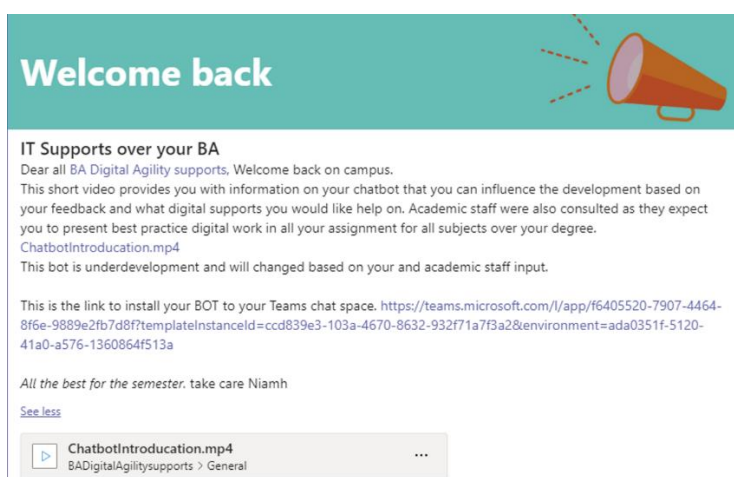


Figure 4-17 Chatbot introduction screencast

This design and development is journaled in detail in Appendix 8, and the study results are presented in chapter 6. These results led to future analysis, exploration, redesign and development.

#### 4.6.3.3. Detailed testing using student interviews and surveys

Prior to the interviews, a pilot interview was carried out with two students, that allowed me to test the questions and feedback from this process. This led to the refinement of some questions. Semi-structured interviews were used with open-ended questions that allowed participants to “best voice their experiences unconstrained by any perspectives of the researcher or past research findings”

(Creswell, 2014, p. 240). To delve deeper into the students' experience in using their chatbot, the interviews used a think-aloud process (Nielsen, 2012) that provided live system feedback on what students were thinking and doing concurrently (Greene et al., 2018). This involved setting up a *Microsoft Teams* meeting with each student; cameras were switched off and students were recorded sharing their screens and navigating the chatbot. The students were encouraged to talk out aloud as they asked the chatbot questions and navigated through different topics in the chatbot. These students were given no instructions on chatbot use and were not directed to perform any specific tasks. This allowed students the freedom to roam and explore, and this open-ended usage captured a variety of perspectives (Jain et al., 2018). Having students involved in the process imparted a learning opportunity for them to see a live research project evolve with their feedback. Two student surveys were also used, one during the semester asking all students views on mobile usage (see Appendix 4) and an additional one at the end of the semester where first year students were asked to complete a survey to ascertain their insights (see Appendix 7). This feedback led to further analysis and refinements in design and development. This will be explored in depth in chapter 7.

#### **4.6.3.4. Academic staff input**

Valuable insights were received from twelve academic staff surveys and they are presented in chapter 6. Initially, I had not planned to interview academic staff members but as the study evolved, I felt it was important to obtain a comprehensive picture of academic staffs' digital expectations as these drive students' digital agility by their expectations and innovation in assignment choices. To gain further insights and to cover the thirteen diverse disciplines, I interviewed eight staff from different departments. These interviews were short - fifteen minutes - which explored digital work they require from their students. Incorporating academic staffs' digital needs into the design process triggered associative thinking of where they used different digital tools that enabled students to use in other disciplines (Schank, 1995). These "Memory Organisation Packet" (Schank, 1995, p. para. 37) I aligned to the digital task the students requested. These cycles of investigating, development, testing and refinement led to the usable knowledge (McKenney & Reeves, 2019). Chapter 7

documents the interview findings and these personal conversations were a valuable opportunity to explore an academic staff digital agility narrative. It also allowed me to share my digital knowledge with colleagues. These academic staff inputs drove future analysis, exploration, redesign and development. Throughout the research project and over each cycle of testing and reflecting on the findings, ongoing updating occurred. This is presented here as the next step in the DBR approach, but this reflection process was ongoing throughout the research study. This is presented in the next section.

#### **4.6.4. Review or reflection phase - ongoing updating**

Deep reflection on the research findings allowed me to revisit the design and refine elements and to then start another cycle of redesigning, testing, evaluating and reflecting (Reeves, 2006). The ongoing updating or “implementation and spread” (McKenney & Reeves, 2019) phase traverses across all the phases as my intervention was piloted on a small group first, six students, and then implemented for all BA students in the college to use. Incorporating a reflective experience of Dewey (1938) or reflective practitioner of Schön (1983) is vital to enhance my intervention. To guide reflection from different vantage points, Brookfield’s four lenses, namely: autobiographical, the students’ eyes, our colleagues’ experiences and the theoretical literature (Brookfield, 2017) offered a holistic understanding to drive the chatbot development. In this research, my self-reflection on personal experience or autobiographical lens allowed me to look at my experiences as a learner and how this influenced the development process of the chatbot (Brookfield, 1998). Inviting anonymous commentary from students and academic staff shaped the chatbot build (Brookfield, 1998). Reflecting on the feedback from students using the chatbot and academic staff digital expectations produced an “effective local intervention” (Hall, 2018, p. 27). I produced “robust, reusable and repurposable guidelines, principles and resource which others can adopt and adapt to achieve similar innovative effects in their own context of learning, potentially reaching many more learners than in the initial (original) design” (Hall, 2018, p. 27). Providing opportunities for others to gain practical outcomes from my research aligns with my teaching mantra, so to this end I documented my

chatbot creation (see Appendix 8), as well as presenting findings and discussions. Data from students and colleagues informed redesign of my chatbot to foster a learning culture to enable students to develop their digital skills in the flow of their learning. Furthermore, using the theoretical lens of self-regulated learning helped to understand the learning process and provide learners with supports to enhance their studies. As declared, DBR is a cyclical process which resulted in cyclical findings that in turn fed into the next iteration of design and development. In this project, three cycles were used, hence the next three chapters present findings from each of these cycles. The next chapter details the key findings from the first cycle of prototype design and development.

## 5. Results from the prototype cycle

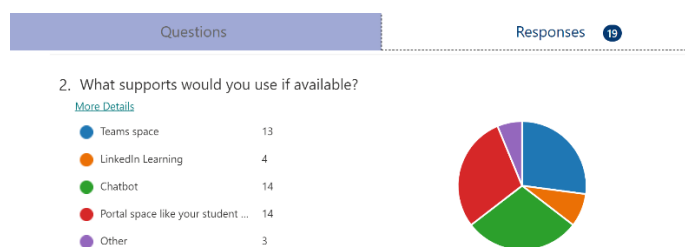
### 5.1. Introduction to three findings cycles

My findings are imparted in the next three chapters that are representative of the three cycles of the design, development and testing of the chatbot and I will briefly comment on all three cycles. My experience in teaching digital competencies in higher education affords awareness to interpret the findings. “Potential implication of findings require sound understanding of the context in which the phenomena are being investigated” (McKenney & Reeves, 2019, p. 111). This chapter discusses findings from the first DBR cycle, the prototype cycle. The survey findings in the cycle ascertained that students are positively disposed to a chatbot, if available. The need to assist students in self-regulation in planning and avoiding distractions became evident from this survey. Next, designing and developing a prototype is recounted, and initial testing undertaken by asking six students is documented. From testing the prototype, students denoted the importance of user control, speed, one place to get help, a simple interface and clear and incremental instruction. Analytics from the development environment furnish additional insight into the language students use when they ask the chatbot questions. The chatbot redesign was influenced by these findings. Finally, the end of this cycle reflects on the initial design principles and aligns these to the cycle findings. These findings fed into the next cycle of development and these findings are set out in chapter 6. Chapter 6 opens with INDEX survey data bringing attention to the poor use of technology to manage their time and lack of diversity in software use other than Microsoft (MS) *Word* or *PowerPoint*. The important role academic staff play in shaping digital agility and signposting transferable skills became evident from academic staff survey data. Students emphasised they will use the chatbot if it helps their academic learning. They were positively disposed to the chatbot’s speed, option to ask anonymous questions and 24/7 availability. Additional insight into the different questions students asked the chatbot and that questions were linked to assignments, for example help organising data, emerged from chatbot analytics. These insights fed into redevelopment and discussed in the next chapter, chapter 7. Chapter 7 distils the prominent role academic staff play in

driving digital agility through strategic assignment design, setting high expectations for digital work and prompting students on transferable skills. Students were positive of the chatbot ease of use, 24/7, speed and liked getting notifications of new features. This result displays they are strategic in the effort they put into assignment work and pitch to the level that is expected. They indicated that they easily get distracted and hence self-regulation direction would benefit their studies. The analytics usage aligns with assignment requirements and thus reinforces the influence of strategic assignment design. Finally, the design principles were reflected on to present the importance of user involvement, simplicity of design, language, functionality and interface and UDL principles in learning supports. The next section uncovers the findings in the prototype cycle.

## 5.2. Exploration student survey results

Due to the extent of the data gathered over the three DBR cycles, I had to be selective, and balance the number of questions reported with how best to present my interpretive story from the data. The initial exploration student survey asked students ten questions; findings from four questions are described below. Nineteen second-year students responded to the question “what supports would you use if available?” (note they could choose multiple answers). Teams, Chatbot and Portal space presented as popular (see Figure 5-1). This feedback presenting Teams, Chatbot and Portal space reassured me that if a curated option was available, they would use it.



**Figure 5-1 Exploratory survey data**

The survey question “What digital questions would you like the chatbot to answer?” conveyed valuable information that I used in my chatbot advancement

of topics. The answers were varied and these three responses present examples of student input:

Producing documents that are professional and look well.

How to do specific things and how to improve my IT skills.

Best way to create a table of contents. Recommendations for the structure of my dissertation.

These student inputs contributed to the knowledge base of my chatbot.

Interesting data manifested from my question 7 (see Figure 5-2) that sought to ascertain students' self-regulation awareness by questioning students' planning, goal setting and focusing capabilities. Notably students were confident in setting goals and confident in accomplishing the goals they set as highlighted in their strongly agree and agree responses in the data. This finding exhibits students begin their self-regulation process, but this may change during the process as they agreed and strongly agreed, to the question on "making too many plans and find it hard to focus" (see Figure 5-2). Technology that can assist students in planning and help stay focused (Anthonysamy et al., 2020) were added to the chatbot. Additionally, their responses to "easily get distracted when they run into difficulty" further shows that they need help with their self-regulation process. Students' responses to "confidence in using new software", "regularly search course-related supports" and "ability to change their plans when things not going to plan" were predominately positive in their abilities (see Figure 5-2).





perceptions of using the prototype and produces data to adjust the chatbot based on user voice or student responses. The next section shows feedback from students testing the prototype.

### **5.3. Chatbot initial user feedback**

Six students tested the chatbot prototype to present to users what the intervention looks like and contributed feedback into a survey. These I have given a pseudonym S1 to represent student 1, S2 for student 2 and continuing to S6. This prototype allowed for reflective practice and evaluation of my intervention which is key in education design work (Hall, 2018). This test and learn approach provide insights into what is working and what is not working with the chatbot. In my initial enthusiasm, I assumed students' ability to use the chatbot but input from student 4 grounded me. S4: "I was a small bit confused at first on how to use it." This was a failing on my part in my assumption that students will automatically be able to use the chatbot, and I valued this feedback and included a video on how to get started and use the chatbot in my next design iteration. The temptation of "feature creep" (McKenney & Reeves, 2019, p. 143) by adding features that were not originally planned, had to be curtailed and this was reinforced by a comment from the feedback. S2: "I think it has the potential to be very useful, as long as, when one asks a question, an answer is given and not too complicated." This comment grounded me in making sure the provision was very incremental and halted the potential to get carried away in the design process by adding too many features in the conversation answer node.

Student 5's comment on getting answers quickly, and available 24/7 was reiterated by all the other students:

I found it very helpful, and it gives you your answer within seconds unlike when you need to email a lecturer or look up your question. I also liked that it asked if the information that it had given in regard to your question was sufficient with a simple yes or no question. (S5)

Speed of reply, convenience and availability anytime are echoed in other research on chatbots (Fryer et al., 2019; Pérez et al., 2020). The importance of having one space to ask questions was disclosed by S3, and this was also commented by S6:

The idea of the chatbot is a good idea, it looks like a lot of the information one might need to do with IT could be easier to access in one app/team page as opposed to going in and out of several apps/websites etc. (S3)

The importance of having one place to address digital questions and purposely designed to provide a student experience that will encourage digital agility. S1 shared a valuable comment on navigating the interface. S1: "I like it so far, it is easy to understand, and I like the way, when you look at a presentation of *PowerPoint* as I did, when I x'd out of it, the whole app did not close." This comment reinforces the need for simple interface design and importance of user control, which aligns with the literature advocating simple interface and user control (Bisser, 2021; Ciechanowski et al., 2019; Nielsen, 1994; Shneiderman, 1985). These comments allowed me to reflect on my research question RQ1.1: What perceived benefits and limitations did students present in the design and development process?

Comments that did not surprise me were the comments on rating the chatbot. When I was testing the chatbot the default end of conversation has a 'rate your experience' built into this topic which I found annoying and this was reiterated by these students' comments, S2: "asked to rate once was ok, but every time!"; S3: "I gave it a good rating the first time, but when asked again didn't sorry"; S4: "asking for rating each time I used digi was frustrating" and S5: "don't like star rating, feels like customer services!" sums up users' sentiments.

The comments above and this comment from S6: "I think it's a great idea, very easy to use and would be a great asset to have" were nice affirmation to continue the chatbot development in providing user feedback and choice and that the assistance was beneficial. When students used the chatbot the

software environment kept a track of usage. These analytics are featured in the next section.

## 5.4. Chatbot analytics

The chatbot analytics presented insights that I used to improve the performance of my chatbot. This dashboard illustrates the chatbot usage in a summary chart of users over a seven-day range (see Figure 5-4). Figure 5-4 imparts an example of these data for one week when students were testing the prototype. The Engagement rate 100%, Resolution rate 100% and Escalation rate 0% and Abandon rate 0% are worth noting here. An engaged session is when the student triggered a topic, which means when a question is asked. This session can end in one of three outcomes. The session was resolved, which means the chatbot answered the users' questions and they entered "Yes" when asked an "end of conversation" survey "Did that answer your question?" The session ended in escalation, means that the user was directed to contact me in person. The session was abandoned implied that the session was neither resolved nor escalated. My prototype testing of 100% resolution rate was encouraging to get verification that the students testing the prototype had their questions answered. The Customer Satisfaction (CSAT) communicates a graphical view of the score of 5 which is also worth noticing as this is the feedback from the rating from the end of conversation survey.

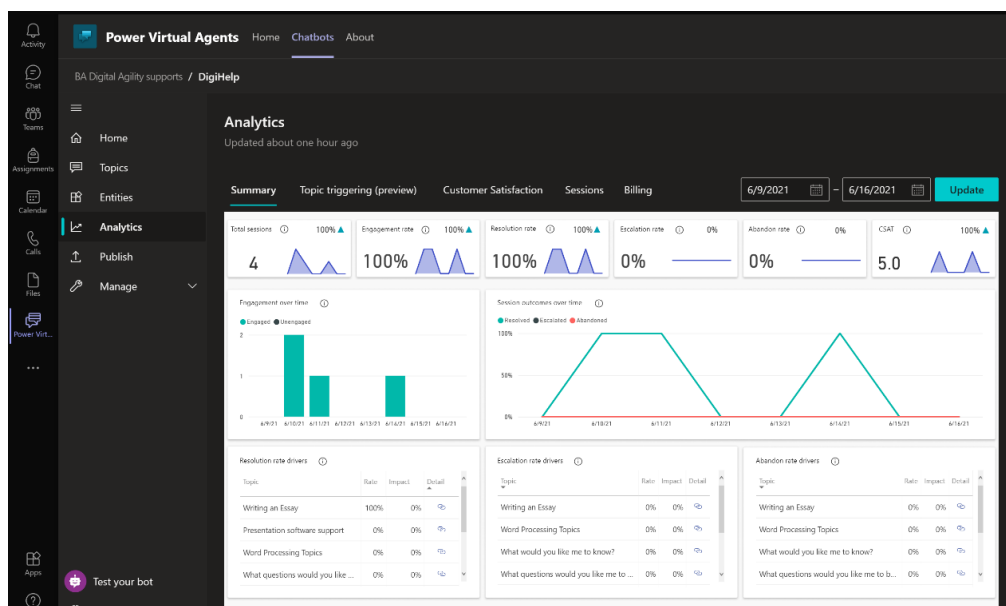


Figure 5-4 Power Virtual Agents analytics dashboard example at testing stage

These findings from the surveys and software analytics supplied insights for the chatbot redesign, these are described in the next section.

## 5.5. Chatbot redesign

The first redesign involved the inclusion of a video; this was prompted from S4's confusion on how to use the chatbot (see section 5.3). In this video (see Figure 5-5), I recorded a screencast for students demonstrating how to add the chatbot to their chat space and an overview of using the chatbot.

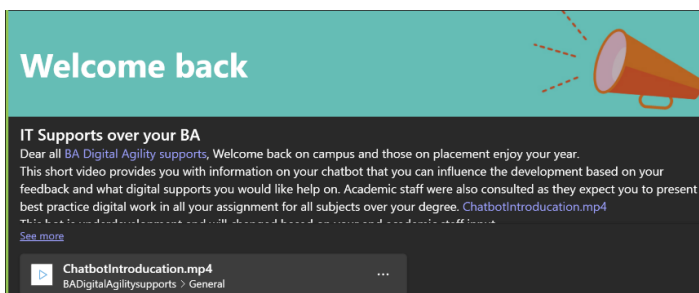


Figure 5-5 Chatbot introduction video mp4

This video was posted in the conversation space in *Microsoft Teams* and all students received a notification of this post (see section 5.3).

The next redesign involved the removal of the default rating survey that appeared each time the chatbot was used (see Figure 5-6).

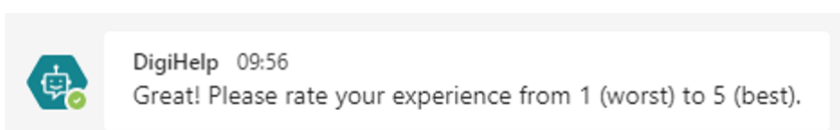
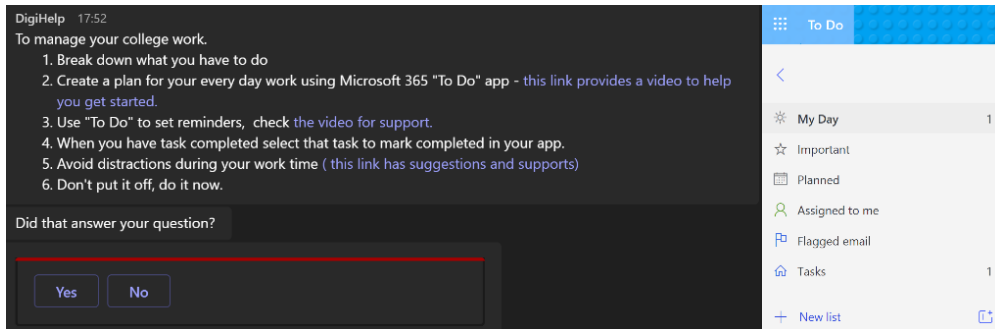


Figure 5-6 Default rating your experience question

Comments from four out of six students (see section 5.3) on finding the feature annoying, prompted this redesign. These chatbot analytics focus on use of the “end of conversation” topic default rating survey which would be beneficial if the bot was only used occasionally but I wanted my bot to be a “go to” space for students to find information on their digital questions. I removed the default end of conversation that included the chatbot rating by redesigning the flow of the conversation and designing another message box to replace this default end of

conversation topic. This removal I had to review again as outlined in my findings in cycle 2.

Another redesign I added was support to use the *To Do* app (see Figure 5-7). This *To Do* app can support students with their time management and their goal setting.



**Figure 5-7 DigiHelp time management To Do app**

Findings from the exploratory survey prompted the inclusion of a variety of topics that students requested, for example planning and organising dissertations. Moreover, these findings allowed reflection on the design principles development that is outlined in the next section.

## 5.6. Design Principles development

Based on user feedback, how did my draft principles reflect in practice? Table 2 offers a brief synopsis of the initial design principles (see subsection 4.6.2.1).

<b>Initial design principles</b>
Principle 1: important users or stakeholders involved in the development process
Principle 2: important that the chatbot presents a personality
Principle 3: importance of an initial message and clarity on what chatbot can do
Principle 4: importance of designing the conversation flow to guide users
Principle 5: supports include clear objectives, learning pathways and feedback
Principle 6: learning designed using iterative, structured but agile approach
Principle 7: build on existing learning and include new learning strategies
Principle 8: importance of user control
Principle 9: design aligns with Universal Design for Learning (UDL) values

Principle 10: clear and consistent language and standards
Principle 11: simple design and input
Principle 12: run on a variety of devices
Principle 13: handle dialog failure and end conversations gracefully

**Table 2 Overview of Design Principles**

The importance of Principle 1, that design is enhanced when users are present in the development (McKenney & Reeves, 2019; Mizuko et al., 2013), is evident from users in their valuable feedback and their suggestions to what topic they want added to the chatbot.

Principle 2: the importance that the chatbot presents a personality (Bisser, 2021) did not emerge from the initial prototype.

Principle 3: importance of an initial message and clarity on what chatbot can do (Bisser, 2021) was also not evident from the prototype data.

Principle 4: I reviewed and adjusted the topics and conversation flows in the chatbot to provide a micro learning guidance as my initial topics were too broad. This also aligns with S2 comment “when one asks a question, an answer is given and not too complicated.” This confirms this principle concerning the importance of designing conversation flow.

Principles 5, 6 and 7 were still underdeveloped in this cycle as I needed to incorporate academic staff digital needs into topic design and this input was delayed due to academic staff workloads and the need to resend a reminder request to fill in the survey.

Principle 8: The importance of user control (Nielsen, 1994; Shneiderman, 1985) was remarked on by a student S1: “when I x'd out of it, the whole app did not close.”

Principle 9: PVA software “is built to be accessible from the get-go” (Microsoft, 2021) and each topic also considered accessibility that is core to this principle. This principle did not emerge in prototype testing.

Principle 10: using clear and consistent language and standards and Principle 11: using a simple design (Nielsen, 1994; Shneiderman, 1985) was evident in student's comments, S1: "easy to understand and use"; and S6 "easy to use".

Principle 12: The chatbot works on a variety of devices (Microsoft, 2017); from testing, I and other students discovered that to add the chatbot initially to *Microsoft Teams* space was not available on a mobile phone device, but once added to *Microsoft Teams* from a computer or laptop the software could then be used on all device types.

And finally, Principle 13: the inclusion of a graceful exit (Nielsen, 1994; Shneiderman, 1985) in the event of the chatbot failing to answer the question was tested more thoroughly in the next cycle of testing.

The initial student exploratory survey depicts evidence that students will benefit from inclusion of self-regulation skills of planning, focusing and management of their learning. Feedback on the prototype prompted the redesign to include an introduction video and removal of rating as disclosed above. In addition, the chatbot's knowledge base was expanded. This cyclical development based on student feedback and input offers insights to address RQ3: What recommendations are there for designing and developing a chatbot to support students' digital agility?

On reflection, this iterative process facilitates the timely developmental changes that students exhibited and they witness these changes that encourage their further input. The next chapter puts forward the next results cycle, cycle 2. This cycle introduces results from students using the chatbot in the course of their studies that introduces authentic use of the intervention.

## **6. Results from cycle 2**

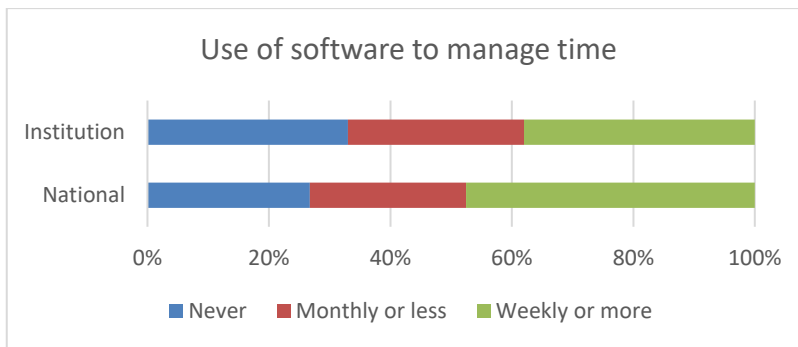
This chapter reports the results from the second DBR cycle. These results informed: RQ1.1: What perceived benefits and limitations did students present in the design and development process?, RQ1.2: What digital questions were not anticipated and should be included in the chatbot knowledge base? and RQ2: What are the students' perceptions of the chatbot for supporting their digital agility?

In addition, the results validated if my digital agile conceptual framework captured the variety of digital needs across disciplines. This cycle involved surveying academic staff to ascertain the digital needs in their disciplines. In this cycle, all BA students had access to the chatbot and input suggestions into a survey in what they would like the chatbot to answer. Analytics from the developer environment raised additional insights on the chatbot use. Data from the INDEx survey, staff and student surveys and analytics from the software all fed into the chatbot redesign and reflection process of the design principles. Data from the INDEx survey is revealed first in the next section to give an overview of the state of the art of higher education students digital experiences in Ireland.

### **6.1. INDEx survey data**

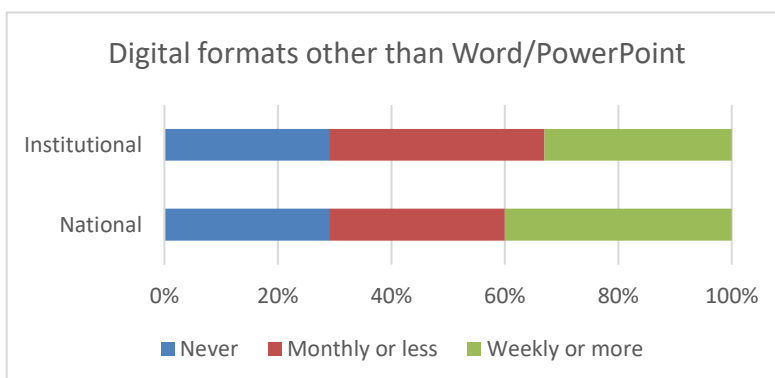
The Irish National Digital Student Experience survey (INDEx) data was used as secondary data to provide a national and institutional evidence base of data. This research was a snapshot of student and staff digital skills in November 2019. For this research, the focus is on student data. Data displayed in section 2.3 described students' agreement of the importance of digital skills but flags that students do not have regular opportunities to update these skills. Drilling further into student responses at national and at institutional levels of students needs awarded additional evidence to include in the chatbot. The data organising and analysis was conveyed in subsection 4.5.8.6.





**Figure 6-1 Software to manage time**

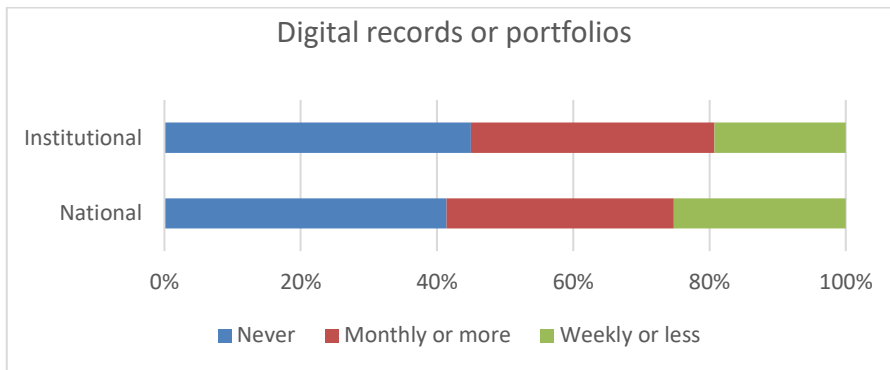
Figure 6-1 displays student use of software to manage their time that detailed only “27% Never, 26% Monthly or less, and 48% Weekly or more” (National Forum, 2020a). At institutional level this is even less, presenting “33% Never, 29% Monthly or less, and 38% Weekly or more” (National Forum, 2020b). This limited use of software to organise learning is voiced by students in section 7.2 and aligns with research by Yot-Domínguez and Marcelo (2017) on students’ use of software to self-regulate their learning, also presented in section 7.2. This brought empirical evidence of the importance of supports for students’ use of software to manage their time to be included in the chatbot knowledge base. This use of software for management of learning is one strand in my digital agile framework.



**Figure 6-2 Students work in digital formats other than Word or PowerPoint**

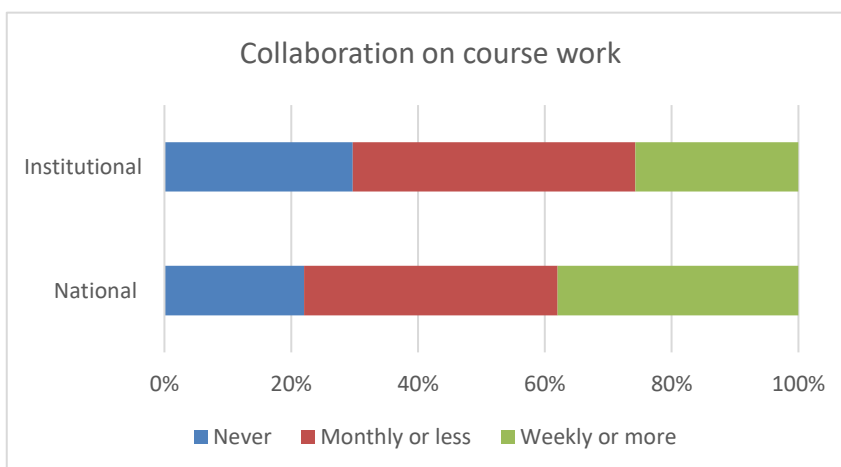
Students were queried on digital work in their academic work. Figure 6-2 illustrates “As part of your course, how often do you produce work in digital formats other than Word/PowerPoint 29% Never, 31% Monthly or less and 40% Weekly or more” (National Forum, 2020a). Institutional level denoted “29% Never, 38% Monthly or less and 33% Weekly or more” (National Forum,

2020b). These data were gathered before the pandemic and the variety of assessments is mostly likely different.



**Figure 6-3 Students digital records or portfolios**

Figure 6-3 states responses “creating digital record/portfolios of learning” detailed “41% Never, 33% Monthly or less and 25% Weekly or more” (National Forum, 2020a). In comparison to institutional data of 40% “Never, 39% Monthly or less and 21% Weekly or more” (National Forum, 2020b). Again, this spotlights the need for more variety in assessments (Flavin, 2017).



**Figure 6-4 Collaboration on course work**

Figure 6-4 states “As part of your course, how often do you – work online with others, 22% Never, 40% Monthly or less and 38% Weekly or more” (National Forum, 2020a). At institutional level it was “30% Never, 45% Monthly or less and 26% Weekly or more” (National Forum, 2020b). Working online with others may have increased since 2019 but is an important skill that students need to continuously develop and software functionally for sharing is part of a common functionality now. The chatbot fosters communication and collaboration on a

variety of different software and communication and collaboration agility are highlighted in my digital agile framework. Notably, 69% Agree at national level and 71% Agree at institutional level that they enjoy learning more when digital technologies are used in their courses.

This digital skills narrative is an integrated part of our BA degree for the last 25 years. As outlined in section 1.3 previously, two modules in the first year teach students digital skills, but these need to be complemented by prompting students to use their skills and present a common academic staff narrative on digital use. The next section describes the narrative from academic staff survey responses.

## **6.2. Academic staff survey results**

In this cycle, I surveyed academic staff to ascertain the digital work they required from their students over all years of the degree. I received valuable insights from twelve academic staff; these academic staff have been given pseudonyms AS1, AS2 and so on. Again, as previously stated due to the large amount of data gathered, I had to be selective with my choice of data to report those that best reflected my interpretive story. The answers below represent five out of nine questions in the survey (see Appendix 3). My survey question, “what digital questions would you like the chatbot to answer in order to help your students?” opened a wealth of data. “How to” questions appeared a lot here and the inclusion on using *Moodle* and technical questions was noted to include in the next iteration of the development. AS8: “How to log in to college systems. Where and to whom to address specific technical questions when problems arise accessing online material”; AS9: “How to share a screen in *Teams*, How to navigate *Moodle*, accessing live lectures, uploading assignments, referencing, copyright and dealing with online timed exams”; and AS10: “They’ve asked me basic questions like how to get email on their phone and are unsure around *Teams* (scheduling meetings, chat etc) I think it would be great to do GDPR with them! Online source finding via the library”. These comments gifted me with data that I included in the chatbot. AS5’s comment “Creative ways of using technology. They have quite basic digital skills (in my opinion).” I liked this aspiration of creative use of technology and this I have

addressed in the variety of software choices the chatbot can assist in. Finding, searching and evaluating information and proper referencing was present in all comments and can be summed up by this comment:

The most useful function I can think of would be one that offered students the means of evaluating a source of information. A major transition to 3rd level is the finding and using of information and content. While helping the students avoid plagiarism directly is perhaps beyond the scope of what you're aiming to do (though that would be \*amazing\*), advanced search techniques (or even just teaching them proper keyword and Boolean searches) would be the most useful. (AS3)

Effective search, evaluating sources, referencing and plagiarism were articulated in ten out of twelve replies and these competencies were included in the next iteration. Each competence that staff mentioned was analysed and categorised under research agility, communication agility, collaboration agility, management agility or data agility. These competencies above can be mapped to the research agility theme in my conceptual framework (see Figure 3-8).

In reply to the question “Ideally, what digital competencies do you wish your students to have in order to enhance their learning experience?”, competencies to effectively, creatively and confidently present information and data were cited by the majority of academic staff. These two comments by AS5 and AS6 are representative:

They need to be engaging in creative ways of presenting material both orally & written. They have presentations as part of the assessment & while I encourage them to be creative (video, screencast, blogs etc) they rarely move beyond basic *PowerPoint*. I use a number of data sources and they should be able to use *Excel* to present data that is tailored to their assignment. (AS5)

and

To be confident using *Word, PowerPoint, Excel*. Be able to insert material into their essays and projects, be able to record presentations and screen share along with being confident on social media. Have a sense of discernment re the use of websites. Important, that they are aware of the technologies that are available on the college systems. (AS6)

These comments on digital competencies academic staff would like students to present aligns with data agility, communication agility and research agility in my framework (see Figure 3-8). These insights solicited valuable data to address RQ1.2: What digital questions were not anticipated and should be included in the chatbot knowledge base? I had not anticipated questions on *Moodle* (our Learning Management System (LMS)) or using the library or GDPR or scheduling meetings or sharing screens and presenting in *Microsoft Teams*. Providing localisation of the language interface I also did not anticipate, with AS1 stating: “Unlike other language depts, all our teaching is through Irish - if we use a tool, it needs an Irish language interface”. PVA does allow you to specify a target language when starting the chatbot design, but Irish is not available at the moment. I included all the other suggestions in my next iteration of development.

Academic staff answers to “What prerequisite digital skills do your students need to successfully engage with the material in your modules?” presented very little prerequisites they required beyond basic skills of accessing *Moodle*, effective searching and sourcing information and basic word processing and presentation software. These three comments give a flavour of comments articulated.

They need *Microsoft Word, Sway & PowerPoint*. They need to be also able to navigate *Microsoft Teams* and also how to use software in a creative way when presenting material. For instance, very few students use any functions in *Word* - integrating tables or presentation of written material (headings, content page etc.) or manipulating data. (AS2);

AS5: “*Word* (use of spell check in different languages), *PowerPoint*, how to access the internet and be critical in their choice of sites; how to install mobile app on phone”; and from AS7: “Very little really. Some spreadsheet skills can be useful for my X module.”

This basic level of requirements was a surprise as I think as a faculty, we need to expect more than these basic skills from students and this in turn would instill a culture in the faculty of best practice use, presentation and high expectations in students’ presentation of digital work. Students received sufficient digital competencies in a first year module and these competencies should align with academic staff expectations in their assignments. High expectations and signposting to these skills would create a culture of learning and agility in digital skills development.

Findings from the question “From your perspective, how would you describe a digitally agile student?” reported a variety of answers to reflect on. These three comments sum up the overall perspective from staff AS5: “A student who is able to use software to present data & material in a creative & novel way. Also, someone who is not afraid to experiment”; AS7: “This is a student who knows how to ask the right questions when they meet an obstruction to their digital work.”; and

A student who is able to navigate new technologies and systems where there is some similarities with a previous version or resource. Basically, a student with a transferable understanding of how certain types of technologies operate – particularly search functions and proxy logins. (AS8)

The creative and novel use of software, someone not afraid to experiment, asks the right questions when needed and able to transfer learning to other software are central to digital agility. From these initial responses this warranted further investigation into digital expectations of academic staff which I undertook in the next cycle of investigation by interviewing eight members from different departments.

In answering my question “Have you any other comments or recommendations that you would like to include?”, again, I received valuable insights. I concur with one academic staff member’s response in the survey of the lack of awareness of students to transfer knowledge from one module to another:

I don’t think students see the value of using material they covered in one module for another - they get the module over and move on. There seems to be a lack of integration in terms of knowledge or skills. So, when they get to my module, it does not seem to occur to them to use digital knowledge or skills in the assessment aspect of the module. Perhaps we need to remind them more. (AS3)

I concur that reminding them more is essential as is the importance in communicating a faculty staff digital narrative. In the same manner, I advocate those assessments can nurture students’ self-regulated learning and this can be developed over an assessment. Another comment:

Given the growth of digital humanities and the central role that digital pedagogy has now taken in our lives, I think that this project is both timely and urgent. I do fear, however, an ‘analogue’ push over the coming months to revert back to the pre-pandemic state, whereas I think that we and our students have learned valuable lessons which we can use to improve our teaching, learning and research. (AS7)

This comment is interesting and highlights the missed opportunity as a faculty community not to share our experiences of these valuable lessons learned. One staff member remarked on more leverage of open access software, and I include examples of open access software and directed students toward resources in the chatbot.

As a faculty, a culture of innovative digital use facilitates learners and academic staff to communicate and interconnect with the potential to ultimately change the way we work, reflect and relate to each other and, in turn, relate to knowledge, information and learning.

These insights unearthed important information to address my RQ1: How can a chatbot be designed and developed to support students' self-regulated learning of digital agility? Involving academic staff in the design conversation is essential, as, over the degree, they require students to present digital work in their assignments. Based on these findings, I contend that the faculty community is paramount to fostering and shaping our students' digital agility by their expectations of digital work, embedding digital capabilities into their modules and fostering a transferable learning culture that enables students to upskill and grow. This was reiterated by a colleague in the comment on lack of integration and that "perhaps we need to remind them more". The competencies featured in frameworks in section 3.3 are reiterated in these findings from academic staff and awareness of how the cross-functional digital skills can scaffold students towards using these as common practice. The next section depicts findings from the student survey data.

### **6.3. Student survey feedback**

This survey was added to the chatbot, in the new end of conversation topic message, and students could fill it in if they found something that the chatbot did not answer or include suggestions for chatbot development. I have continued my student pseudonyms S20, S21 and so on. Students' requests were varied from how to reference, help with undergraduate dissertation layout, and how to create interesting presentations.

Student comments on how they found the chatbot are represented here by these three comments - S22: "I never looked at the apps we have available to us in M365"; S7: "I thought we only had *Word, Excel, Outlook* and *PowerPoint, Teams* there are hundred!"; and S23: "Maybe questions regarding how to do some project or college work more efficiently, how to use app that I am unfamiliar with etc. These will be great to know after college also."

These comments highlight awareness of software available to use to develop their learning and the comment on them being useful after college indicates the student is reflecting on their digital needs. This opportunity to review skills was emphasised in the INDEX survey.



From the INDEx survey data, 38% of students agreed they had regular opportunities to review and update their digital skills while another 38% articulated a neutral response (National Forum, 2020a). The chatbot provides students with the opportunity to get help in the flow of their work and ask questions and get immediate answers when needed. This comment from S20 aligns with this:

I think that because the chatbot can be used 24/7 and there is no wait time in response, it would be more efficient and most likely used more often than emailing a lecturer. Also, because there isn't a person on the other end, it would encourage people to ask for help if they were worried about asking a 'stupid question'. (S20)

The benefit of asking a chatbot for help instead of a person, "to promote participation of shy students" (Pereira et al., 2019, p. 548) and "the possibility of interacting anonymously becomes a main enabler" (Pereira et al., 2019, p. 548). This 24/7 availability provides just-in-time education that will build student confidence to improve their documents by knowing there is help available that is aligned with their needs. S28 commented that "it will give me confidence when producing document that have to be professional and look well, the information to just check quickly is easily laid out in your presentation, with the bot asking question too". S24 commented "The videos and files you provided are easy to understand and step-by-step to follow, even if I need to watch them a few times"; this conveyed that the chatbot resources were useful to students. S25 remarked on the usefulness to get quick and easy snippets which made me reflect on topic design and provide snippets of micro learning:

I think the chatbot might be useful in plenty of situations. For example, doing a PP presentation, it's easy to start a presentation, but one can get bogged down with trying to make it interesting and eye catching, and giving snippets of how it can be improved quickly and easily, would be very handy and like having a personally assistant to ask. (S25)

The use of a chatbot that allows students to have personal academic assistance on campus and off campus and that focuses on the needs of the student enhances the learning environment (Villegas-Ch et al., 2020).

S27's comment "I am also more confident going into apps on *Microsoft 365* and looking around to see how I might utilise them in the future" was very reassuring as it presented the goal of the chatbot development that they developed confidence in using apps and encouraged reflection on how they can transfer them to other work. S22 articulated that "I will definitely use this bot if it helps me in my course work" indicates that course work expectations can encourage students to develop their digital skills. These next comments from S23 and S19 align with the importance of chatbots being clear about their function (Microsoft, 2017). S23 stated: "like how DigiHelp said hi and said what it could help on" and another comment from S19: "liked how it provided a list of help, and the help had text, graphics, video or links so I could get quick tips or more detail if I needed it". These comments articulate the importance of strategic use of multimedia to promote learning in instructional interventions (Mayer, 2017).

These comments drove the momentum to progress the chatbot and imparted insights to reflect on my RQ1.1: What perceived benefits and limitations did students present in the design and development process? This student input articulated the benefits of availability 24/7, immediate reply and anonymous asking of questions.

A limitation that S20 noticed was that:

The chatbot was trying to keep up a conversation even if I had moved past my question. I had asked about presentations, got a resource, then I asked about saving, and it said it didn't understand that and then gave me more options about presentations. There doesn't seem to be a way to reset chat. (S20)

This was interesting and while I could not recreate this error, I put a post to ask students if they had issues and include screenshots. I received a reply and discovered this happened when the chatbot was in the middle of a conversation

and the student tried to ask it something else. Breaking the conversation flow causes the chatbot to present a message “Sorry, I did not understand” as it is working on one topic and then interrupted. S20 voiced an insightful awareness of this in their comment “I think maybe the *OneDrive* question in between upset the result.” Other limitations at this stage were not reported but maybe this was due to the novelty factor for students in having a chatbot available to them to answer their digital questions 24/7. My next section produces data from the chatbot analytics.

## 6.4. Chatbot analytics

Feedback from the prototype testing led to removing the default end of conversation topic that included a rating. Removing the default “end of conversation” topic was a mistake as it was linked to analytics in the software for abandoned rate and now presented abandoned rate the same as the engagement rate (see Figure 6-5). This also reported resolution rate data to 0% which lost this useful metric (see Figure 6-5).

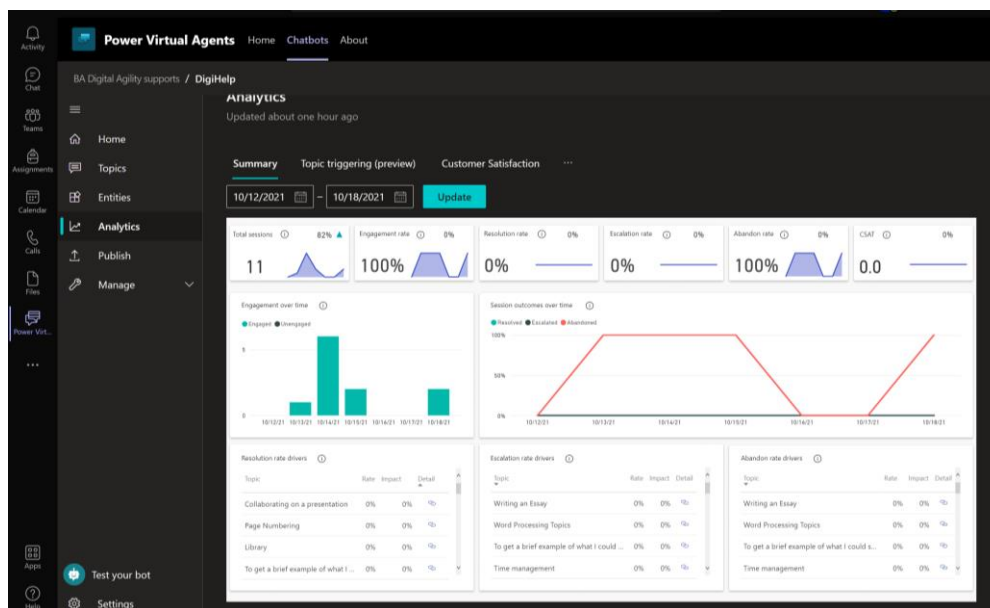
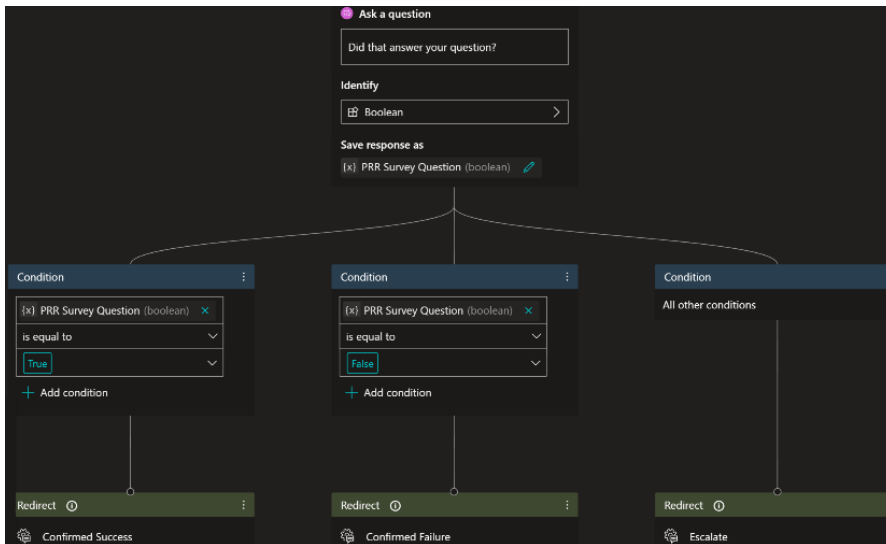


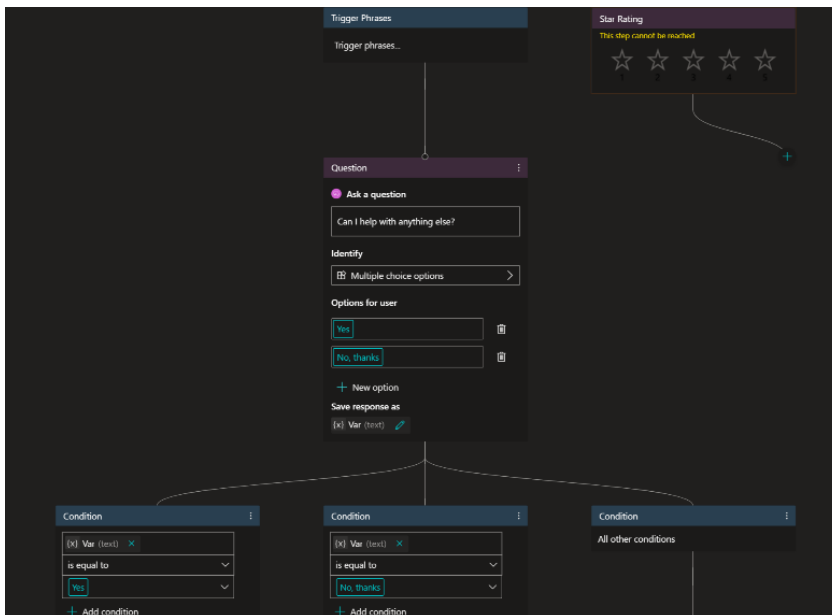
Figure 6-5 Power Virtual Agents Analytics Engagement rate and Abandon rate.

To rectify, I reinstalled the “end of conversation” topic but this time I drilled into its design (see Figure 6-6).



**Figure 6-6 End of conversation topic authoring environment**

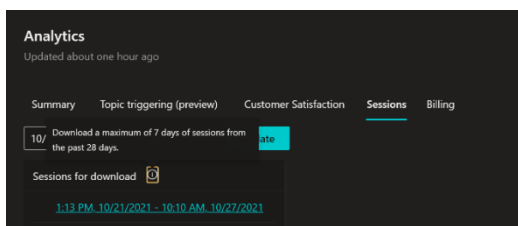
The “end of conversation” topic used a Redirect to “Confirmed Success” topic that I edited to bypass the node for the rating survey as the option to delete this node was not available. This presented a warning in my topic design environment as the step cannot be reached (see Figure 6-7) but the topic would still run for users.



**Figure 6-7 By passed star rating in authoring environment**

This redesign was significant work as it entailed editing the authoring environment in all 102 topics to change the path of the conversation for each topic to direct to the “end of conversation” topic. Another metric that was lost

was the removal of “Did this answer your question?” “Yes” or “No” data that linked to the resolution chart data. S5 had commented that they “liked that it asked if the information that it had given in regard to your question was sufficient with a simple yes or no question” hence this redesign was important. To delve deeper into the data on chatbot use, there is an option to download the chat transcript in the session downloads as an *Excel* file format, .xmls. This is cumbersome as a restriction in the *Microsoft Teams* version of PVA is that sessions are only available in seven-day time stamps from the past twenty-eight days (see Figure 6-8).



**Figure 6-8 Sessions Analytics download environment**

I undertook to download sessions every week to gain insights from these data (see Figure 6-9). Analysing session information allowed me to look at chat transcripts in the format “User says:, Bot says:” structure (see Figure 6-9).

A	B	C	D	E	F	G	H	I	J	K
1	SessionId	StartDate	InitialUser	TopicName	ChatTranscript	SessionOut	TopicId			
2	a:1WRjTL6l	10/20/2021	saving	OneDrive	User says: one drive;Bot says: To clarify did you mean;;User says: OneDrive;Bot says: Sorry	Abandonec	new_topic_98ea693808a34b58a958cc9ebdd49a7			
3	910f42d9	5/10/18/2021	how to set	Meeting us	User says: how to set up a meeting;Bot says: The quickest way to set up a project meeting	Abandonec	new_topic_b5fad6f98b5f4ad5a3dc9221bed1d035			
4	a:182yFNV	10/19/2021	recording	Recording	User says: excel;Bot says: This is a basic example of what type of support I could answer in	Abandonec	new_topic_e95d14f7e0f24f48ad3c92775a5f6145			
5	a:182yFNV	10/19/2021	References	References	Bot says: Ok I'll start over.;Bot says: Hi! I'm a virtual agent. If you use me I will keep improv	Escalated	new_topic_5eb8cc35c4264196950b9f2cd339aef8			
6	d4b4395f	10/19/2021	excel	Spreadshee	User says: hi;Bot says: Hi! I'm a virtual agent. If you use me I will keep improving and addin	Abandonec	new_topic_0f73df20f2e4d6696241bcd5041b5b6			
7	D8uskD63F	10/18/2021	collaborati	Collaborati	User says: collaborating on documents;Bot says: Save your file to OneDrive to access your c	Abandonec	new_topic_7bfff7d6ca793415d8853239ecb2443ab			
8	667bec7b	-10/14/2021	styles	Styles Basic	User says: styles;Bot says: Styles: The best way to ensure consistent formatting in a Word	Abandonec	new_topic_f42445c7a4e24214a4b7240bd749e300			
9	a:1F5BhRh	10/15/2021	No typing	No typing	User says: How do you activate you microphone for dictation in Microsoft word if it is not	Abandonec	new_topic_7ed9a8909a854a3e897a9446b3b7dce6			
10	a:152jWV	10/15/2021	video	Insert a hyp	Bot says: Hi! I'm a virtual agent. If you use me I will keep improving and adding more stuff	Abandonec	new_topic_7dada8e138804ee8a91c3dff5d45d2be			
11	ad251f7c	-10/14/2021	collaborati	Collaborati	User says: collaboration on a presentation;Bot says: [Information document on presentatio	Abandonec	new_topic_0cf72963f4d8453ea8c1412ccc3412dd			
12	2c5zu9eiaP	10/14/2021	powerpoint	Presentatic	User says: powerpoint;Bot says: These are a few examples of what presentation support	Abandonec	new_topic_c0cfc1a751944bdf9e35af9eddb81b34a			
13	ExqlmDPaf	10/14/2021	styles	Styles Basic	User says: styles;Bot says: Styles: The best way to ensure consistent formatting in a Word	Abandonec	new_topic_f42445c7a4e24214a4b7240bd749e300			

**Figure 6-9 Excel session download example**

This analysis defined insights into what the students asked the chatbot and from these data I redesigned the trigger phrases in some of my topics.

I also found insights that I did not expect, for example how to activate a microphone as indicated in this transcript:

User says: How do you activate you microphone for dictation in *Microsoft Word* if it is not working?; Bot says: To clarify did you mean;;

User says: None of these; Bot says: Sorry I am not able to find a related topic. Can you rephrase and try again?; User says: How do you reactivate your mic for dictation in *Microsoft Word*?; Bot says: To clarify did you mean:; User says: No typing Dictate instead of typing your work; Bot says: Dictation allows you to use speech-to-text to author content in Word with a microphone and reliable internet connection. On the Home tab choose Dictate. Click the cog to open the menu to see Auto punctuation and spoken language. You can set up dictation...; Bot says: Thank you for using this space and your input in filling in form below. (DigiHelp)

This transcript provides an example of the text detail of one session and these sessions facilitated the keeping track of questions asked and keywords used. These data insights were taken into account in the chatbot redesign.

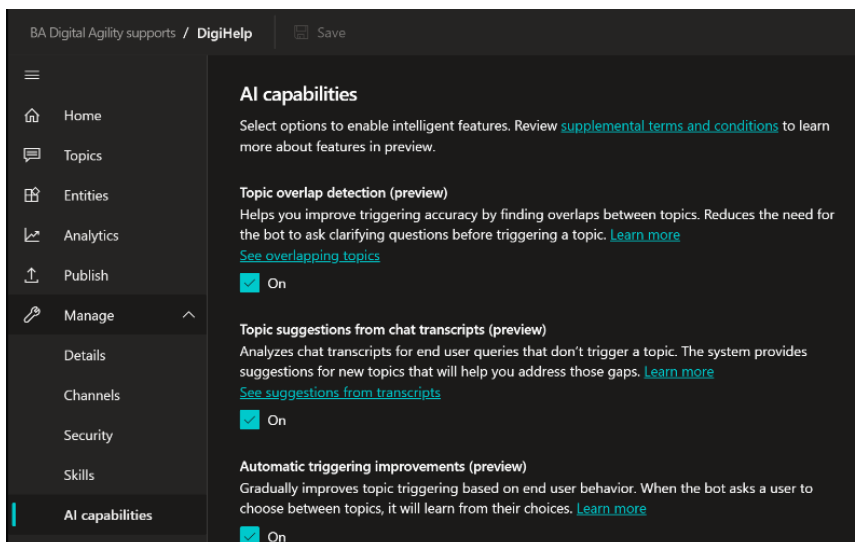
From these session data I could see trends in student questions, for example three students asked similar questions, “how to create a quantitative survey” and “presented result in graph form”. In my chatbot design I had included information on data collection and presentation of data in chart format. As these questions were very specific, it was likely they were specific requirements in an assignment. To follow up students’ questions in the chatbot, I purposely emailed five academics to ask for details on their assignment work so I could anticipate questions for assignments. In one of the replies from one staff member, they remarked that it “nice to see a bit of joined up thinking!” and I discovered that one part of their assignment requirement aligned with the student question above, but this assignment was submitted before our conversation. This highlighted the need for this “joined up thinking” and my narrative that we need a digital narrative across our degree and the potential of timely signposting and curating different resources to enhance students’ digital work they present.

In one week, there were seventeen questions on “how to present better?” This aligned with two disciplines using presentation assignments. The original design had help for students to create engaging presentations using best practice design and Artificial Intelligence (AI) functionality. As a reaction to students’ questions, I included additional resources to show students the AI feature

available in MS *PowerPoint*, Rehearse with Coach as presented in the next section on chatbot redesign.

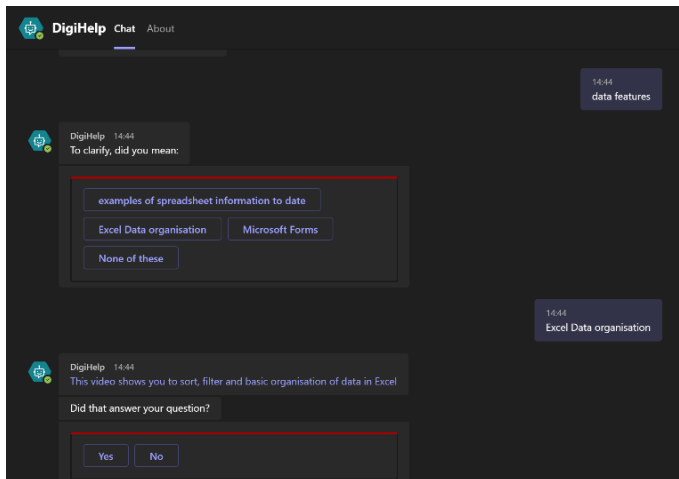
Another limitation of chatbot analytics was that “the Bot says” does not include the choice options the software presents to the user if their question is ambiguous or if there are several different directions that might be pertinent. An example of these choices is indicated in Figure 6-11 after findings on Artificial Intelligence (AI) capabilities.

Further insights were found by turning on AI capabilities to get insights into topic overlap detection (preview) allowed the refining of topic and use the capabilities of preview AI features in the chatbot (see Figure 6-10).



**Figure 6-10 AI capabilities in preview**

The software used natural language understanding to look at the trigger phrases used in my initial design and recommend options for the users by asking the question “Do you mean” when the chatbot is unsure of the question (see Figure 6-11).



**Figure 6-11 Trigger phrases suggested by chatbot**

Developments in “automatic trigger improvements (preview)” allow the chatbot to learn from the students’ responses, and when another student asks a similar question, the “Do you mean” question will not be asked. This automatic trigger feature adds to the student experience in using the software. These analytics from the chatbot, along with staff and student survey input, influenced the redesign that I discuss in the next section.

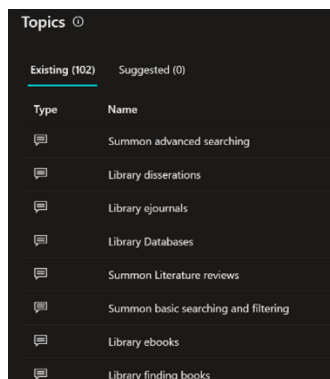
## 6.5. Chatbot redesign

Based on testing, I had to rethink how I had initially designed topics from general keywords to be more specific and think of topics as small individual conversations on a specific subject. This rethinking of topic design as paths students took when interacting with my chatbot took considerable redesign to take into consideration the conversation flow, conversation habits of the target audience, and the phrases or keywords students would use to trigger the topic for conversation. Six nodes or options were available to include in the conversation development; these were Ask a question, Add a condition, Call an action, Show a message, Go to another topic and End the conversation (Microsoft, 2021). Detailed planning is needed to consider a conversation flow (Bisser, 2021) and provide a space that guided students’ digital journeys.

Based on academic staff and student feedback, my topics expanded from 18 in the initial prototype to 102 topics (see Figure 6-12) in this cycle. Including this range of topics addressed the limitations part of my RQ1.1: What perceived



benefits and limitations did students present in the design and development process? This refinement was influenced by the number of requests from students and suggestions from academic staff from their survey. In this development, I added eight topics to direct students to navigate specific areas of the library catalogue (see Figure 6-12), as this was brought up by both students and academic staff as paramount to student learning.



**Figure 6-12 Library catalogue topics**

To address my RQ1.2: What digital questions were not anticipated and should be included in the chatbot knowledge base?, I included *Moodle* resources, searching library catalogue and this development evolved with continuous suggestions from staff and students.

Redesign based on data from session analytics presented the need to include additional timely resources. Due to the number of questions on how to present and help presenting, I added additional guidance to align with these students' needs. Rehearse with Coach feature allows students to practice talking through their presentation and the software providing real-time feedback on their presentation and at the end a presentation report. This report provides a summary of the presentation, with analytics on the pace, pitch, use of fillers, originality, repetitive and inclusive language. An additional feature available in MS *PowerPoint* for the web is analytics on audience engagement on body language if students have cameras turned on. This functionality and accompanying analytics are invaluable to give students the confidence to present in public but importantly for privacy reasons no video or data is stored on this rehearsal. To signpost this to students, I posted a notification to direct students to this material (see Figure 6-13).

**"Help Presenting" available in chatbot**

BA Digital Agility supports Dear all, I hear a lot of you have presentations due and to help you practice your presentations type in "Help presenting" into the chatbot and you will get information on PowerPoints new AI feature. All the best with your presentations. Niamh

**Figure 6-13 Help presenting notification to direct students to AI feature in PowerPoint**

Support for data gathering and presenting was also evident from the chatbot analytics. To align these to students' questions, I redesigned trigger phases to direct students to specific topics and not be offered general choices when asking, for example, "how to create a quantitative survey", students were automatically directed to the relevant video resources. These insights open reflection opportunities for my digital agile conceptual framework and for my design principles.

**6.6. Design Principles development**

This cycle of data allowed me to reflect on my initial design principles and test these against my chatbot use. Table 3 reports an overview of design principles similar to Table 2 that is included to remind the reader.

<b>Initial design principles</b>
Principle 1: important users or stakeholders involved in the development process
Principle 2: important that the chatbot presents a personality
Principle 3: importance of an initial message and clarity on what chatbot can do
Principle 4: importance of designing the conversation flow to guide users
Principle 5: supports include clear objectives, learning pathways and feedback
Principle 6: learning designed using iterative, structured but agile approach
Principle 7: build on existing learning and include new learning strategies
Principle 8: importance of user control
Principle 9: design aligns with Universal Design for Learning (UDL) values
Principle 10: clear and consistent language and standards
Principle 11: simple design and input
Principle 12: run on a variety of devices
Principle 13: handle dialog failure and end conversations gracefully

**Table 3 Overview of Design Principles**

Principle 1: Data from surveying students enhanced the chatbot as it aligned the topics with students' requests.

Data on Principle 2 on the chatbots persona emerges from student interviews in the next cycle.

Principle 3: Designing a clear introduction message and description of the chatbot capabilities presented a good first impression to students (Bisser, 2021; Jain et al., 2018; Microsoft, 2017). The comments from S23 and S19 on how they liked how the chatbot made students aware of its capabilities was portrayed in section 6.3.

Principle 4: Designing conversation flows (Bisser, 2021; Microsoft, 2021) is an ongoing development process with addition of different topics suggested by students and staff.

Principle 5: Presentation of clear learning objectives, pathways and feedback (Gagné, 1985; Salmon, 2016) was voiced by S19 in liking the different options and paths to navigate text, video or links.

Principle 6: Topics were added and adjusted to align with users' and academic staff requirements, for example, inclusion of *Moodle*, referencing and presentation resources.

Principle 7: Data from surveying academic staff enhanced the chatbot by highlighting real-world problems, aligned the expectations of academic staff and included topics to cover a variety of disciplines, for example additional presentation resources were incorporated into the design.

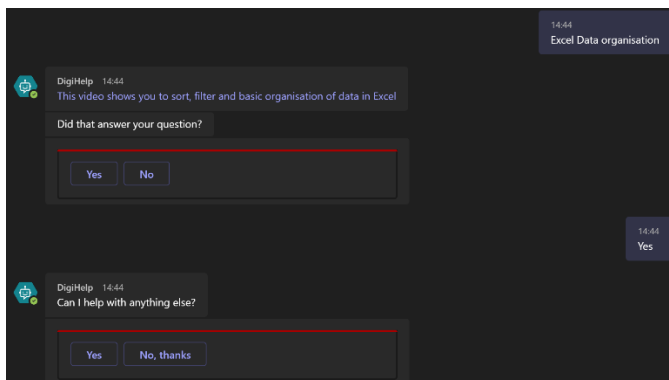
Principle 8: User control and Principle 9: accessibility are always central to the design. Principle 9, the chatbot can support the goal to provide learners with access when needed (Rose et al., 2014) and utilise the presentation of a variety of means, for example use of animation, cartoon, mind maps, text documents, screencasts and video resources. Students have a choice in how to organise and demonstrate their learning (CAST, 2017) using the variety of help available.

Interviews with students in cycle 3 provide live insights into students' use of the chatbot.

Principle 10: Clear and consistent language, and Principle 11: simple design (Nielsen, 1994; Shneiderman, 1985), were all continually considered in the chatbot development.

Once students added the chatbot to their *Teams* space using a computer or tablet they had no issues with mobile devices, Principle 12.

Principle 13: End conversations gracefully (Nielsen, 1994; Shneiderman, 1985) was mentioned by S20 in stating there was no option to reset. The inclusion at the end of conversation "Did that answer your question? Yes or No" and "Can I help you with anything else" brings the conversation to a graceful conclusion (see Figure 6-14).



**Figure 6-14 Chatbot end of conversation interface**

This cycle allowed me to reflect on my chatbot design and development and align my chatbot to student and staff needs. The inclusion of clarity in what the chatbot can answer, use of plain language, simple design, user control, understandable learning material and conversation flows, and graceful end of conversation, as highlighted in the literature and supported by my findings, is important for chatbot success. Reflecting on this cycle, the INDEx results at institutional level clarifies the need to encourage more diversity in software use. This can be shaped by variety in assignments students are required to do and the influential role academic staff play in shaping digital agility and signposting transferable skills. The next chapter describes results from the last cycle, cycle

3. This cycle displays findings from academic staff interviews, students' interviews and surveys, and analytics and finally reflection on the design principles development.

## **7. Results from cycle 3**

This chapter details results from cycle 3 and focuses attention on the influential role academic staff play in driving this digital agile agenda. Correspondingly, communication and collaboration with students facilitated the shaping and guiding of the chatbot. Students became aware of their strengths and weaknesses when creating digital assignments and used the chatbot to seek and access information to improve their creative work. The analytics on chatbot use displays students sought help when they had to record presentations and these analytics coincide with assignment demands. This awareness and help-seeking is at the core of SRL. This cycle imparts results from interviews with academic staff, from the students' think-aloud walkthroughs of the chatbot, two student surveys and from software analytics. These results set the foundation for the chatbot redesign process and for design principles development.

### **7.1. Academic staff interviews**

Interviews with academic staff provided a valuable opportunity to explore disciplinary practices, insights and perspectives from eight departments in the Faculty of Arts. Pseudonyms were assigned to academic staff interviewees ASI - ASI1, ASI2 and so on. These interviews furnished the opportunity to discuss my problem and ascertain the spectrum of faculty staff digital needs. The diverse insights influenced the choice of topics for my chatbot to provide students with targeted digital assistance for their studies. Interviewee ASI5 voiced "students in Higher Education have greater learner autonomy compared to what students experienced in schools and as academics we could support this more... this demands they are self-motivated, but many students need a push!" This comment stresses learners' responsibility for goal setting and organising but with encouragement. This comment aligns with my narrative of promoting and integrating self-regulation academic activities into the chatbot design. While undertaking assignments, students go through SRL processes of comprehension, planning, strategising and evaluating (Zimmerman, 2002). This process can be cultivated by effective use of technology. The importance of staff digital awareness was referred to by ASI8, who stated "the need of both students and staff to continuously update their digital knowledge base as

software evolves and we need to keep abreast with these changes". As a faculty community we should have a strategic digital agenda for staff to continually review their digital skills and to share and communicate their digital knowledge and skills. While staff digital agility is not this study's focus, it is emerging as an important factor in driving a 'digital agility' agenda. There was a consensus amongst interviewees across different disciplines in relation to which digital skills were important, for example, effective searching, critically evaluating digital sources of information and citing references, using digital tools to collaborate, effective presentation of work and data organisation, management and presentation. This trans-disciplinary consensus aligns with my key components for students to be agile in the management of their learning, research, communication, collaboration and data (see Figure 7-1).

Unfortunately, the findings demonstrated a disconnect among students transferring digital skills acquired in one module across to other modules even across intra-disciplinary modules. ASI4 stated "they don't seem to make the connection between the modules, even modules in the same discipline". The themes from my thematic analysis of academic staff interviews captured the story presented in my digital agile framework, i.e. research agility, management of learning agility, communication agility, collaboration agility and data agility (see Figure 7-1) (Braun & Clarke, 2019). In addition, the theme of programme design presents as key to driving digital agility transferability.

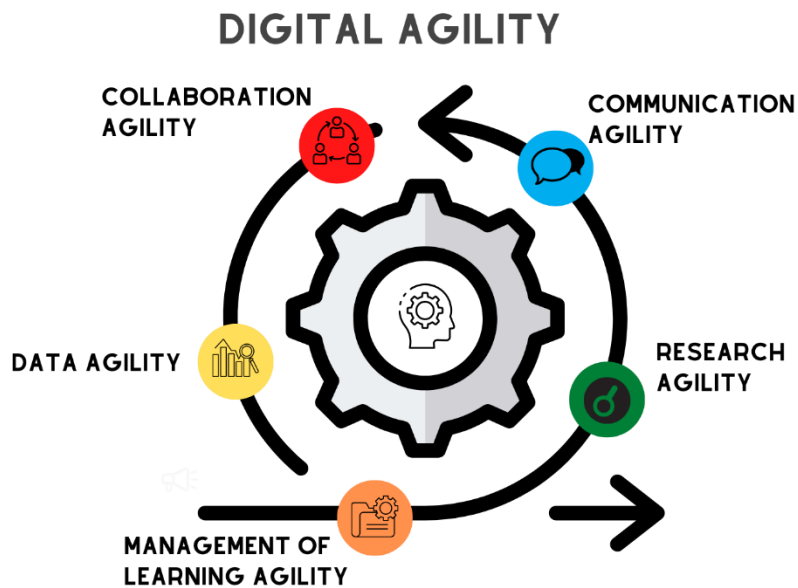


Figure 7-1 Digital agility key components

### 7.1.1. Research agility

Filtering and searching databases for relevant collections and inconsistent referencing was articulated by all eight staff. This comment by ASI1 is representative of the research skills that were most strongly emphasised by academic staff: “how to discriminate between reliable and unreliable academic sites, ability to navigate library database and the importance of consistency in referencing is a basic requirement”. These strategies of searching for information and resource management are central to SRL. The lack of awareness among students in using effective searching techniques was cited by interviewees. This echoes research by Yot-Domínguez and Marcelo (2017) on university students’ limited information search capabilities and lack of use of software in referencing (Yot-Domínguez & Marcelo, 2017).

Lack of referencing knowledge and inconsistent referencing was highlighted by five out of eight staff. Two staff members seem to promote manual typing in referencing. Software allows the presentation of data in a variety of formats and if students are aware of the important fields needed to reference correctly and present consistency in referencing, for example, author, journal, year, place, publisher, DOI, etc., this can be manipulated using software to present the reference in numerous style formats. Academic staff use a variety of referencing



styles and software can make these stylistic variations easier to navigate. This aligns with the importance of knowing what data are needed to generate an effective outcome.

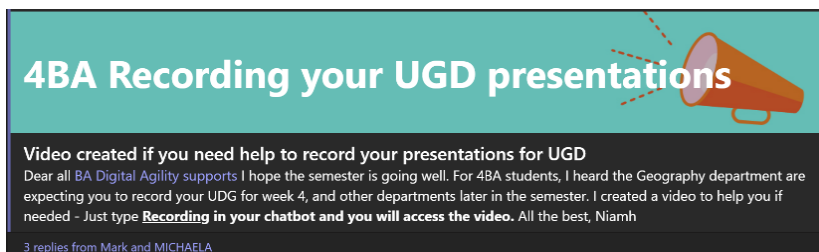
To nurture these academic requirements, I designed material on effective searching using Boolean search and directed students to valuable library resources in the chatbot. Additional assistance for referencing was included to build awareness of the importance of consistency and the different referencing styles used in their disciplines. These in turn feed into students' communication of their research in essays, presentations and other assignment work and are fundamental academic research skills that provide the foundation for communicating their research outcomes.

### **7.1.2. Communication agility**

All academic staff articulated on the importance of good communication skills, and the ability to write clearly, articulately and persuasively. Humanities students should learn and think critically. Five academic staff commented on the lack of awareness of effective style usage by students in their assignments. This was disappointing to hear as students receive comprehensive instruction and resources on the use of styles, pagination and referencing functionality. To this end, I asked two academic staff members who had assignments if they could include in the assignment instructions on specific styling and pagination. ASI8 added this to their assignment and directed students towards the chatbot. ASI8 stated that "initially assignments were very professionally formatted, but students who submitted late or got extensions presented poorly formatted work. Having said that I will include instructions in the assignment on how they should present their work again". ASI8 also referred to careless referencing or lack of detail in referencing, for example no page numbers.

For students to share their research, good communication skills was voiced by all academic staff. Oral presentation of work is a common assignment that is required of students. ASI1, ASI3, ASI5 and ASI6 articulated that they expected students to record their presentations for their undergraduate dissertation

projects. To remind students of this process I created a screencast and included it in my chatbot design (see Figure 7-2).



**Figure 7-2 Chatbot ongoing development**

This was appreciated by students, e.g. S3 stated “the video helped me just when I needed it”. This recording functionality was unfamiliar to some academic staff that I interviewed and to this end I gave a demonstration of the functionality to colleagues. This functionality includes a teleprompting option, an option to insert a video feed as a cameo and the option to record over one individual slide if there is a mistake or a point that needs to be updated. Additionally, the options to export to different file formats and to upload to *Microsoft Stream* facilitate the setting of permissions on video sharing, the generation of a transcript of the presentation, the inclusion of interactive quizzes and the provision of analytics of the number of views. Furthermore, MS *PowerPoint* can provide UDL assistance by using the functionality to keep track of accessibility issues throughout the design process. For example, the accessibility tab and task pane highlight lack of alternative text, hard to read text contrast and effective use of placeholders for screen readers to read.

Other presentation software was also spoken of. ASI6 expected students to use *SWAY* to present their assignment work. Students did not mention that they created a *SWAY* presentation in their first year and this again emphasises the gap or lack of awareness among students to transfer learning from one module to another. This reinforces that, as a faculty community, we need to communicate and share practices as we are enablers for trans-disciplinary competencies transfer.

ASI3 used presentations for a group assignment, and I asked if they would include a few points with the assignment to promote presentation design

features to include. ASI3 also directed students toward the chatbot. ASI3 commented that “presentation work looked very professional designed. One group used a zoom feature to separate their individual contributions”. I showed ASI3 the feature to add different sections to a presentation and create a summary slide to navigate these different sections. Additionally, students are shown the AI feature “design ideas” that provides design suggestions as you work, and this functionality gives no excuses for unformatted and poorly designed student presentations. Students presenting work require a holistic understanding of communication as the capacity to communicate is not just confined to oral delivery but incorporates multimodal use of text, audio, visuals and body language. Group assignments required students to communicate and collaborate on their work. *OneNote* is a tool that can be used for communication and collaboration.

ASI2 specified using *OneNote* as an alternative to essay assignments. They were positive about this alternative and are looking to use this assignment option more in other department modules. ASI2 noted that portfolios captured evidence of learning, showed a record of development, and allows the presentation of different media. ASI2 said “the portfolio fostered a learning process that students work incrementally on planning and revising their work”. This comment aligns with the belief that evidence collected in portfolios can assist with critical thinking and deep learning (Scully et al., 2018). In the portfolio, students “planned, set goals, searched for information, reviewed their work, and evaluated their work” (ASI2). The portfolio process of collect, select, reflect and share initiates students’ SRL processes. To further develop a SRL environment, I gave ASI2 a few suggestions on administration based on ten years’ experience using *OneNote* in my teaching and learning. *Class Notebook* provides assignment administration that allows for the creation of a content library space that only the lecturer can edit, a private teacher space, a collaborative space that all students can use to share information and communicate and an individual student space that only the student and the lecturer have access to. Academic staff can provide feedback in *OneNote* in different format, text, audio or verbal and video, and the option to link to a rubric helps students to compare their work to what success looks like. Also,

*OneNote Math Assistant* can assist mathematics students to practice and solve equations.

Zimmerman and Tsikalas (2005) articulate using technology enhanced learning environments to be leveraged as self-regulatory tools to enhance learning. These features were new to ASI2, and they said they would like me to present to their department next semester on how to set up portfolios for their students and I was happy to agree to this. I shared my experience of using *Microsoft Teams* since 2018 as a learning space for students instead of *Moodle* for my second year modules and the inclusion in *Microsoft Teams* of the *Class Notebook* helps this assignment administration. The functionality of linking an assignment to a rubric allows students to compare their work to this rubric and reflect on changes they need to make to align their work with success criteria thus provoking student SRL. Students can include oral presentations into their portfolio space. In my portfolios I ask students to provide a one-minute video summary of their learning. This process gets students to reflect on what they have learned with the goal of transferring their research to other disciplines. Collaboration and sharing across the faculty will promote a common digital narrative and collaboration is another key competence students need to learn.

### **7.1.3. Collaboration agility**

Three academic staff mentioned collaboration and group work. ASI7 commented that when students did group work, “they used *WhatsApp* to communicate in groups and shared documents on *Google Drive* and then designed a presentation in *PowerPoint* and emailed it”. They were happy with this work but from my point of view I was disappointed. I told ASI7 that I could not understand why they did not use *Microsoft Teams* as one communication and collaborative space for efficient workflow as I know that group were shown all the functionality of *Microsoft Teams* in a module two years before. ASI7 stated that so long as they did it and used an analogue of getting there on the scenic route! I retorted why? when there was a motorway! We laughed and ASI7 appreciated where I was coming from and will direct students to the chatbot to trigger their prior learning in the future. Students unfortunately are making work for themselves, and their workflow and groupwork more cumbersome by not using software that provides

seamless collaborative, communication, and file sharing functions in one place. Reassuringly, one student when interviewed did comment that they used *Microsoft Teams* and found the video on the chatbot very useful. Academic staff using group work, group interactions and co-regulation in assignments should set expectations for students to use software to communicate and collaborate efficiently as this is a transferable skill they will use outside college. Another transferable skill is data agility that is detailed in the next section.

#### **7.1.4. Data agility**

The process of collecting and analysing data to identify patterns and interrogate the data for trends was voiced by four of the eight academic staff members interviewed. Literacy, in this context data literacy, requires the ability to find, read, interpret, analyse and make meaning, and communicate and draw conclusions from data (OECD, 2021). The OECD places data literacy as one of the core foundations for future learning in the spectrum of prerequisites in a curriculum (OECD, 2021). Data literacy is at the core of ASI2's module, first year students are required to extract, analyse and interpret data from various sources and analyse and present this data in graph format. ASI3 required first year students to undertake a quantitative survey, present the findings in graph form and include observations and reflections. Both assignments were already submitted before I communicated with ASI2 and ASI3 which was unfortunate as data organisation, analysis and presentation is included in the chatbot. ASI3 commented on the supports available, stating "nice to see a bit of joined up thinking!" Data awareness, and the ability to manipulate, analyse, present and interrogate data are important transferable skill that students receive in their IT skills module (see section 1.3), but not until the second semester in first year, so academic staff communication is important to reinforce these data literacy competencies.

While digital visualisations were strongly evident in assessment work, it became evident that colleagues did not consider competencies in data visualisation, organisation and filtering skills that students could transfer into their modules. To this end, I collaborated with ASI1 who uses spreadsheets in modules. I demonstrated to this colleague all the help and resources that students received

in organising, filtering, sorting, use of pivot table features and other visualisation features. ASI1 was amazed with the lack of transfer of these skills to their module. I demonstrated a detailed overview of pivot tables to my colleague to present and analyse data effectively and this is now used as an integral part of their module. This colleague now explicitly reminds students of their prior learning of digital competencies in their first year module when asking students to undertake data organisation, management, analysis and presentation. ASI5 used charts and graphs in their modules and again was amazed at the depth of graphing competencies students gained that, again, did not transfer into their module. This reinforced the trans-disciplinary exploration of digital work that could be nurtured as a digital spine in our degree programme. Students build a portfolio of their digital work in their first year modules, but these digital competencies seem to be parked and not used in other modules. Students, now, as a result of the pandemic, undertake more assignment-based assessments and using the competencies of research, data, communication, collaboration and management of learning will make this process easier and more efficient. The next section segues into findings of management of learning.

#### **7.1.5. Learning management agility**

Advancement of competencies in organisation, planning and time management were cited by five academic staff as foundational capabilities. The use of technologies in learning management were not cited. Different software can be configured to accomplish similar tasks, hence the importance of always placing learning objectives and pedagogical goals first. Use of the learning management platform, *Moodle* as a learning space to upload assignments and use of *Turnitin* was cited by all academic staff. This finding was also evident from the academic staff survey. AS9 stated that “how to navigate *Moodle*, accessing live lectures, uploading assignments” were available in the chatbot. The use of online assessments was amplified because of the pandemic and to aid students, academic staff supplied detailed assignment upload instructions and *Turnitin* use. Including *Moodle* features and how these features can support students’ learning is important. Another academic staff member made an

interesting comment: “Most students just look at resources and do not download for future reference. So, when I refer back to the material in another module, they have no reference point. This is exacerbated by college’s administrative protocols, in archiving courses” (ASI3). This aligns with research from Yot-Domínguez and Marcelo (2017) on students not downloading resources. The point that students do not have access to past modules is mitigating against students seeing transferable skills and connections across modules, that could be rectified with communication with academic support staff. Two academic staff described discussion boards and wikis facilities in *Moodle* as communication, collaborative and assessment tool. Again, to progress students’ academic work academic staff specifically informed students in their assessment instructions on their expectations in communications in their forums and wikis. The use of audio but not video recording in conjunction with text documents to explain their assignments was referred to by one staff member and this inclusion is of benefit to a variety of learners.

Access and sharing safely, and security awareness were recognised as competencies that students need help with. They stated a discrepancy between students sharing of digital work outside academic work. Creating conditions for communication, sharing, access and exchange of knowledge in module designs, and providing resources in the chatbot encourages and formalises this further. In sharing and communications, students need to understand copyright and attributions, and this was cited by numerous academic staff as a deficiency in students’ work. The inclusion of information in the chatbot on copyright and attributions and usage rights were added in cycle 3. This can also be integrated specifically into assignment instructions that use of images and media in presentations need to be cited and attributed to the owners. Explicitly including in assessment criteria these competencies will foster and shape students’ sharing and communicating of copyrighted work appropriately when planning and completing assignments.

Planning, goal setting and time management behaviours are core self-regulation processes (Pintrich, 2000; Zimmerman, 2000) and technology can be leveraged to help plan, manage time and set goals. Also cited by academic staff

as being important was use of notetaking, annotation and referencing. Likewise, academic staff expectations of students' cognitive abilities to organise, synthesise and link information to prior knowledge is evident. Technology tools are available to make these processes easier and with knowledge students can build these into their workflows. To this end, the chatbot provides guidance to students to leverage technology to manage their learning. These insights from a snapshot of academic staff from their experiences with students provide valuable findings that were integrated into the chatbot design and will be included in future first year module planning. These transferable skills iterated above should be embedded into programme design, which is narrated in the next section.

#### **7.1.6. Programme design**

The theme of programme design was articulated by four academics. Students in higher education are responsible for their learning, but “some students do not have the skills or learning strategies to cope with the transition to third level and the demands of academic modules” (ASI3). Programmes can be enhanced by integrating strategic learning strategies that incorporate flexibility and differentiation (Flavin, 2017; Peters & Romero, 2019). The importance of including specific competencies in programme design to guide students is present in findings (Flavin, 2017). ASI4 commented on course design: “Courses could be designed around key concepts, graduate attributes and skills - rather than discrete modules and semesters. A Problem Based Learning (PBL) approach to the course, and more coordination across modules”. This seems to suggest that creativity in course design is stunted by traditional ways of doing things. Higher education structures and academic tradition make change difficult in HE (Moore et al., 2018). There needs to be an attitudinal as well as behavioural shift to change established educational and administrative practices (Moore et al., 2018). ASI1 wanted to change the focus, to be on getting students to enjoy their chosen discipline and not to focus on assessment:

No exams in First Year. Pass/Fail based on attendance and engagement and getting them to problem solve and reflect. Try to steer



students away from rote learning in an effort to get them to enjoy and understand the subject material. (ASI1)

Not assessing students and providing students space to love their discipline, is an idealistic vision. From conversations with academic staff that had a module that used pass/fail they reported that students did not engage with the module and take the module seriously. This also aligns with this research that students are assessment focused and only engage and become motivated if work is linked to assessment. Section 7.2 introduces students' comments and data on assessment motivators.

ASI3 commented that “no student is average”, each has their own individual differences in intelligence, prior learning, cultural and other differences. Barkley (2010) calls attention to the awareness of how the learning process is enhanced by connecting with what learners already know and building on it:

Learning is a dynamic process that consists of making sense and meaning out of new information and connecting it to what is already known. To learn well and deeply, students need to be active participants in that process. This typically involves doing something – for example, thinking, reading, discussing, problem-solving, or reflecting. (Barkley, 2010, p. 94)

This thinking, reading, discussing, problem-solving and reflecting is at the core of a liberal arts degree. These academic staff reflections of wanting students to enjoy and understand their discipline, and of focusing on graduate attributes and awareness of our diverse student needs can be amplified by effective digital use. Pedagogical digital competencies were publicised in the suite of digital competencies students need to support their academic work (Flavin, 2017; Pettersson, 2018). In the next section, I share some knowledge from my experience in embedding digital agility into my students' learning environment.

#### **7.1.7. Sharing my expertise**

It is in my nature to share, and to this end, when I am aware of software that will assist staff, I share my experience. ASI3 asked “how did I have the insight to

create a faculty *Microsoft Team* before the lockdown?” They commented on how useful the videos are to give an overview of how *Microsoft Teams* could be used. I told them that I set it up as a reaction to a *WhatsApp* message I received from a colleague in China on Feb 7th, 2020, that their “whole school going virtual for three weeks tomorrow due to the virus”. I thought in the event it happened here, we have a space for faculty staff communication. I thought it would be an advantage for department communications to have a shared space to store files and work collaboratively on documents, if needed. I contacted each department separately on 12<sup>th</sup> February 2020 to show them how to create a private channel, and also I created two videos to demonstrate how *Microsoft Teams* may be of use. Our faculty administrative staff were also included as they had not used *Microsoft Teams* previously. This team was setup to share with faculty staff my knowledge of using *Microsoft Teams* since 2018 and was not part of my PhD work, hence no information from this team is documented in this research. This was mentioned by a colleague, and my aim for including a brief overview here is to demonstrate my motivation to share my knowledge with faculty staff that is outside the remit of my role as a lecturer.

To give colleagues something back for their time for an interview, I shared different software ideas they could implement and demonstrated my use in practice. One thing that was surprising was that academic staff members on college committees did not get experience in using *Microsoft Teams* other than just as a basic meeting interface. These committees did not use *Microsoft Teams* to share files, link to *SharePoint* file space or use the meeting functionalities to manage meetings. *Microsoft Teams* was the main communication space for administrative support staff and all staff working from home and from observations of the software use, it is not used to its full potential to streamline work practices. I gave ASI5, ASI7 and ASI8 a demonstration on using *Microsoft Teams* and ASI5’s comment “thanks for the tutorial on *Microsoft Teams*, really useful to see it in action like that” represents their gratitude. This giving back aligns with my research philosophy and starts the conversation for digital agility among academic staff which in turn will distil to the students. Findings are advocating the need to implicitly embed digital expectations into our modules and assessments and making digital

expectations the norm among academic staff. A forum for departmental communications and cross departmental collaboration would benefit this awareness of what digital work other colleagues expect.

Interesting comments that were repeated a few times in the conversations was how software changes so quickly and how to know which to learn that will last some time. These comments align with sentiments that digital “knowledge shelf life is limited” and that there is a “risk of knowledge obsolescence” (Gilles et al., 2019, p. 35). The importance of academic staff presenting an agile digital narrative is paramount to students’ embracing of digital agility as it seems not unreasonable to argue from my findings that students are strategic in pitching or aiming just what is expected of them. This evidence indicated students being strategic in their response to assessment as emphasised in the next section and in Figure 7-5. Integrating a digital spine across faculty programmes of best practice in digital use would build students’ digital capabilities (McAllister, 2018). Student interviews are detailed in the next section.

## **7.2. Students’ think-aloud interviews**

The think-aloud technique provides a formative understanding of students’ lived experiences using the chatbot live (Nielsen, 2012). The process afforded the opportunity to put questions to six students and get immediate thoughts, reactions and capture their interactions using the chatbot. This feedback from the target audience underpinned and drove the chatbot design and development. I was heartened to see how easily they navigated the chatbot interface. All students were positive about the speed with which the chatbot answered their questions and valued having one specific place to look up digital questions. These three responses are a flavour of their initial reactions: SI1: “liked it, easy to navigate and know I can use it any time when I need to check something”; SI2: “quick really good, you just type in a word and it gives you an answer or options to pick”; SI3: “having this 24/7 and getting immediate responses when I pop in a question will help my assignments”. When SI5 was navigating and typing in keywords they were surprised that it gave options to choose in the format of auto-suggestion buttons, they had not come across that previously. SI5 “really liked the way it showed choices and you could choose

from the list, speeds up searching, I didn't see that before. I only used it when I needed to check on an assignment". This was also commented on by SI6:

didn't think of those button choices when I type in "essay" but makes sense that there are different things that you might need, like planning your essay, or formatting, inserting references, adding a table of contents, captions and table of figures, page numbering, using dictate and lots more I didn't know *Word* could do, like similarity checking or inclusiveness checker.

Findings from Jain et al. (2018) also favoured the dynamic nature of auto-suggestion buttons and how participants like them as they help save time in their searching and improve their interaction with the chatbot.

SI6 commented on the similarity checking function which was also mentioned by SI2: "that one was new to me, great that when I copy and paste from web, I can see where I got my work to reference properly". I pointed out that unfortunately to date the references are not linked yet to the managed sources option in *Microsoft Word* and similarity checking are only available in the web app version. This is a reminder that the software we use updates automatically and usually different features are added to every update that reinforces the need to be digitally agile. Students' perceptions of the chatbot for developing their digital agility were positive. Favourable comments in relation to aspects such as ease of use, 24/7, speed and choice provide data to address RQ2: What are the students' perceptions of the chatbot for supporting their digital agility?

There were two comments from students that indicated they were not aware of the chatbot's knowledge base, for example charts which would have helped their assignment work. SI5: "I did not think of asking the chatbot for stuff on charts, that chart information you know was what I needed for my X assignment" and SI6: "how to design a survey and help on creating chart would have been handy for my X assignment". This brings to light the importance of a coordinated faculty staff communication strategy and awareness of digital expectations to provide students with the best possible student experience.

The comments on the different levels in each topic were very important as the topics were purposely designed to take into account different levels of competencies and the different stages in their degree. SI1 stated, “really liked how sometimes I could just get the information from the text part, but if I needed more help there was a video to view” (see Figure 7-3) and SI2: “good that when I just needed to check something quick the text gave the info”. This differentiation is fundamental to student experience and allowed students to self-regulate the level of information they required.

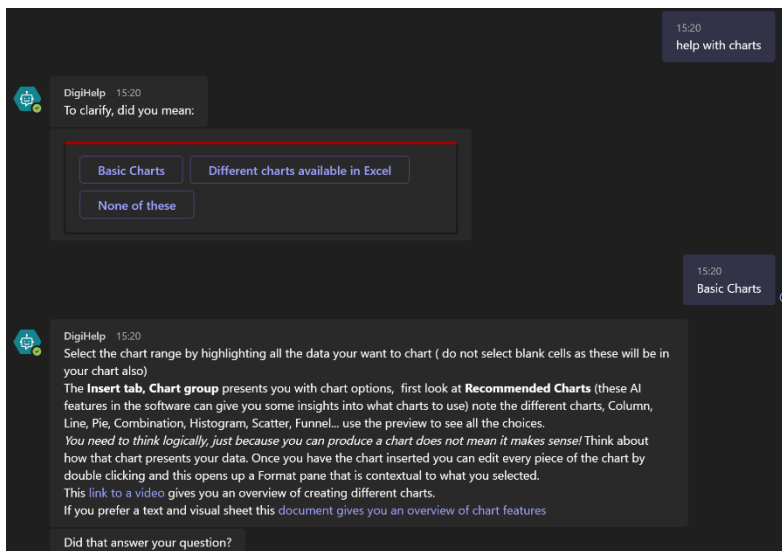


Figure 7-3 Chatbot interface

SI4 mentioned they liked that every week they got a notification to check out something on the chatbot. “I learned things that I did not know existed. It was also great that when we had to record a presentation a notification reminded us there was a video to help. This video I found really useful” (SI4). SI5 also commented on the notification that directed them to recording a presentation and “video help was really useful” (see Figure 6-13). This inclusion of timely notifications that were aligned with assignment work further indicates the benefits of communication among academic staff of the digital requirements in their different disciplines. Using relevant instructional content and “tuning-in” to students’ needs is critical in engaging learners (James, 2018). This provision of resources influences motivational processes by sending timely notification to empower students to regulate and take control of their learning (Winkler & Söllner, 2018). The inclusion of notifications and the timely help that aligned

with discipline needs enabled students' self-regulation, which addresses RQ2.1: What factors will enable students' self-regulation?

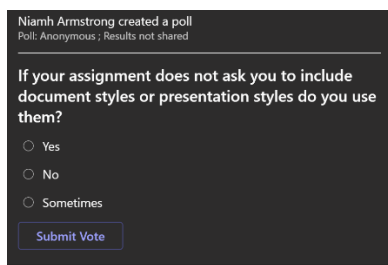
On the question, "Was the chatbot support useful?" students' responses were positive to the supports available as evidenced in these comments: SI2: "yes, we as students do not have the required skills we need when we come to college to complete assignments"; SI5: "yes, it is as it helps me outside of college as well and I didn't know how to use all features of *Word*, *Excel* and *Microsoft365* before"; SI1: "benefit hugely while doing assignments and presentations"; SI3: "Yes, because it shows us simple and faster ways of doing things with regards to components and tasks that are a part of our courses and how to correctly do said tasks in an academic environment"; SI4: "It provides essential fundamentals to carry on into studies in any course. We had a group project that like I had to organise and used *Teams* to video call and edit the presentation, the chatbot video helped us"; SI6: "hadn't used the chatbot before" and when asked "why?" SI6 replied "thought I was ok with IT stuff but now see lots I didn't know". These comments reflect that students if required to use a certain competence will check it out if they see a connection to their assignment. These comments reiterate the importance of making technologies simple, convenient and easy to use that enrich students' experience and outcomes (Flavin, 2017).

Revision of information covered in their first year IT sessions was a common comment: SI2: "revision of things we have done before in IT skills we do quite a lot in the classes and don't always remember what we did"; SI1: "screen recordings of the different tasks are a help when you are stuck revising at home"; SI4: "video guide useful so students can refresh their minds"; SI4 also commented that it will be a useful resource over the degree "handy later in the degree when doing UGD and also very handy to see all the questions and replies in your chat space to look at again" (SI4). This comment on the archives of the chat conversation provides students with a record of their question and chatbot answers in their chat space.

When asked "Is there anything that you would like included in the chatbot?" there were a variety of comments: SI1: "useful things to help with assignments";

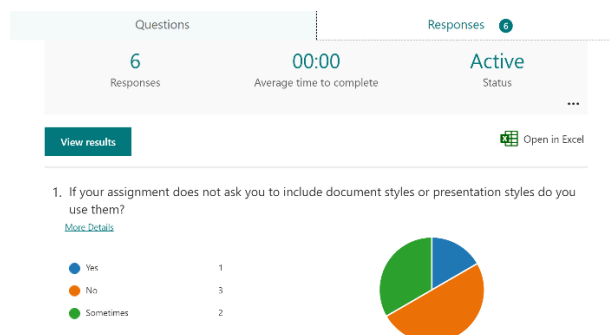
SI2: “more on *OneNote* because it helps for notes and how to use *Moodle* better”; SI3: “anything to help with essay writing and other assignments”; SI4: “essential knowledge for college”; SI5: “whatever IT skills are necessary”; and SI6: “whatever I may need to use in college, nothing more”. These comments focus on whatever they need for college work could be interpreted that as academics if we require specific knowledge students will seek to use it. The comment on using *OneNote* for notetaking and using *Moodle* better were also referred to by academic staff and I took this under consideration and added to the chatbot knowledge base.

To further interrogate students’ strategic use of digital tools, during the interview I asked the six students to reply to the poll “If your assignment does not ask to include document styles or presentation styles do you use them?” (see Figure 7-4).



**Figure 7-4 Poll on digital use in assignments**

The result is stark as only one out of six students (see Figure 7-5), would use their knowledge of digital competence in assignments if not required, but this aligns with comments from academic staff, for example, AS5: “they rarely move beyond basic” indicates the urgent need to address this.



**Figure 7-5 Results from poll**

As a follow up, I asked “why?” and this comment is representative: SI6: “sure didn’t think I needed to, only content is examined”. To further investigate this, I asked two academic staff for a selection of assignments they received but importantly with student information removed and I was shocked at the lack or very basic level of digital use. This reinforces the need to guide students to present work in a professional manner.

From observing students’ use of the chatbot, they navigated the system with ease and were positive of the speed and detail of answers they were provided. I enquired on what they thought of the name, logo, greeting and overall language use in the chatbot. SI2’s comment is typical of the general reply “think the name suits it, and logo a simple robot that is grand. It uses clear simple language that is easy to get and follow, so all good”. The persona and language usage of the chatbot is an important design feature that contributes to chatbot use (Bisser, 2021). This comment is important to ascertain students’ perceptions of these design features.

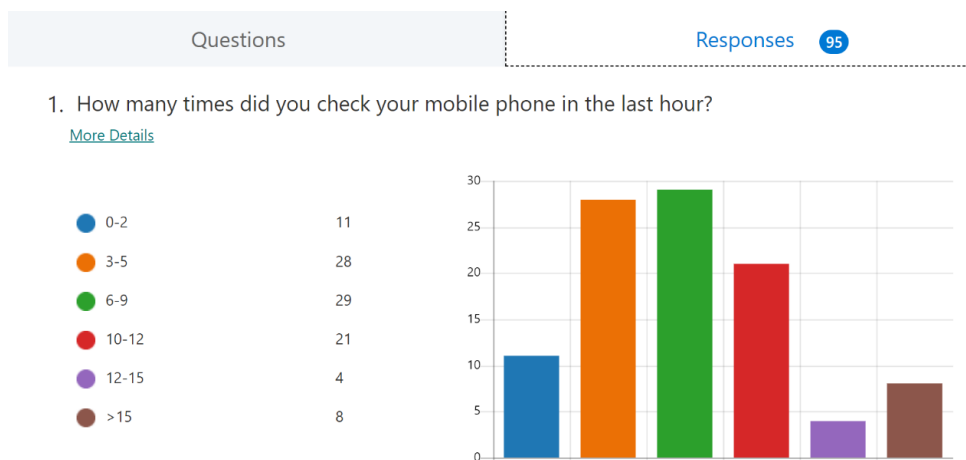
I asked students what digital tools they used to plan, manage, organise, take notes, and support their learning. All students spoke of storing files on *OneDrive*, one used the calendar app and one talked about using *OneNote* to take notes. I added resources to the chatbot to counteract this lack of leveraging of apps available, for example, *To Do*, *Planner* and *Project*. This finding aligns with research by Yot-Domínguez and Marcelo (2017) on university students using technologies to self-regulate their learning “even when they are frequent users of digital technology, they tend not to use these technologies to regulate their own learning process” (p. 1). Students never, or hardly ever, synced their electronic resources, downloaded podcasts for playback, illustrated superficial use of information processing or used time and information management software (Yot-Domínguez & Marcelo, 2017). This echoes findings from academic staff interviews on lack of awareness in search and management of information. The tools students used continuously were “internet information search and instant communication tools” (Yot-Domínguez & Marcelo, 2017, p. 1). These findings identify the need to implicitly include digital instruction into assignments to direct students to include as part of the



assignment process. This integrated approach should infuse technology into students' workflow and perpetuate confidence in digital use. The next section details additional insights from student survey data.

### 7.3. Student survey feedback

These findings present survey data during cycle 3 and the final student survey. Interesting results from 95 students on the number of times they checked their mobile telephone in the last hour shows 62 out of 95 checked their mobile telephone more than 5 times (see Figure 7-6).



**Figure 7-6 Students' mobile phone usage in one hour**

It could be deduced from these data of the need to provide guidance for students to manage their learning and focus their attention on the task at hand. This lack of attention and the importance to provide help to manage student learning are factors that hinder students' self-regulation, relating to RQ2.2: What factors will hinder students' self-regulation? Results from "what is your most frequent activity", as featured sending text messages and updating *Instagram* or other apps as the predominate uses (see Figure 7-7).

2. What is your most frequent activity?

[More Details](#)

[Insights](#)

<span style="color: blue;">●</span> sending text messages	46
<span style="color: orange;">●</span> taking photos	10
<span style="color: green;">●</span> updating Instagram or other a...	29
<span style="color: red;">●</span> voice calls	0
<span style="color: purple;">●</span> search	10



**Figure 7-7 Students most frequent activity on mobile phone**

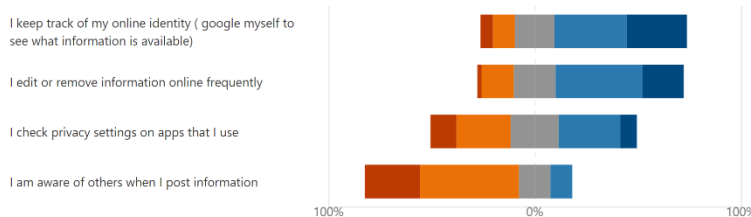
Notably, the predominate use of text messages and zero use of voice call reinforces the design choice of choosing a chatbot and not including a voice option in the design.

To get a brief snapshot into students' digital awareness, students were presented with questions on keeping track of their online identity, checking privacy settings and their social responsibly to others when posting (see Figure 7-8). These data provided insights into students' online behaviour and were useful to consider in the development of students' management of learning.

6. Digital awareness

[More Details](#)

■ Always 
 ■ Very Often 
 ■ Fairly often 
 ■ Occasionally 
 ■ Never



**Figure 7-8 Students' digital awareness**

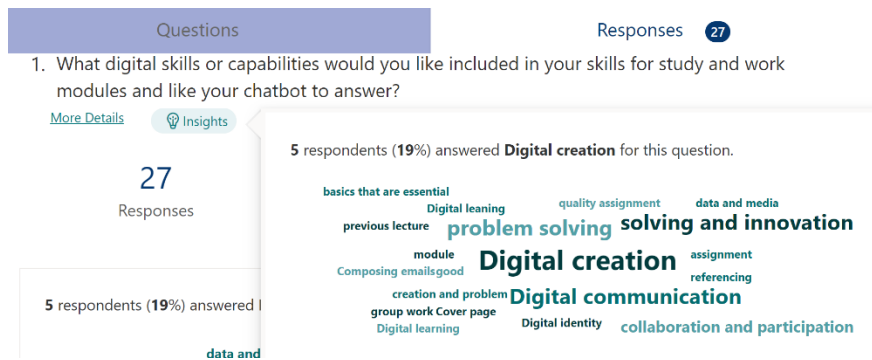
Positively, students were aware of others when posting information but notably they did not keep track of what information in their own online identity or checked privacy settings on apps they used. Making students aware of their online information and privacy was included in the chatbot, as this is also important for students' overall digital use.

Findings asking students whether they check their sources, 26/95 presented “Yes” (see Figure 7-9), reiterated the need to educate students more in this area.



**Figure 7-9 Survey question on checking news sources**

The final survey responses from twenty-seven first year students in reply to the question “What digital skills or capabilities would you like included in your skills for study and work modules and like your chatbot to answer?” included an image of the Jisc digital capabilities framework’s six elements (JISC, 2019) to ascertain how aware students were of what they had covered in IT. An open text box was provided for students to type in their responses. Figure 7-10 shows insights from the responses that students would like digital creation, digital communication and problem solving to be included in their module and chatbot.



**Figure 7-10 First year survey responses to digital skills or capabilities question**

These replies seem to indicate that students are not making the connection with the digital work that they create as part of the module to the text “digital creation” and “digital communication”. These data reinforce the need to use a common language so that students understand the competencies they are gaining and can ensure they are aware of these transferable skills and competencies.

For this final survey, first year students were given pseudonyms 1BAS1, 1BAS2 and so on. Valuable comments arose from students' responses: "more referencing, different apps to help college work" (1BAS1), "a little bit more about referencing but liked the informal easy way to ask stuff" (1BAS6) and "simple basics that are essential to completing a quality assignment. e.g. Cover page, how to move slides from one place to another, how to take a screenshot, etc." (1BAS7). These comments on more referencing and help for college work and assignments are available in the chatbot but students need to be reminded and directed to the chatbot for answers to their referencing and assignment questions.

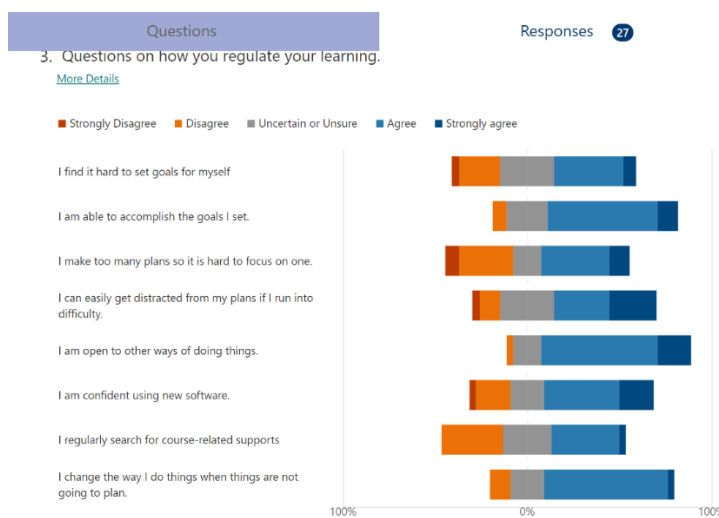
The results to the question "If you used the chatbot how did you find it? If you did not use it, why not?" These comments were very positive about its use: "like having one place to ask questions" (1BAS1), "I didn't always use it but when I did, it was always very useful" (1BAS6) and "I found it beneficial" (1BAS26). Some students said they didn't use it, with no elaboration, and some students felt they did not need IT help. "I have not used the chatbot as I haven't needed to" (1BAS13). Another student commented that "I didn't use the chatbot because I didn't know much about it" (1BAS25). This honest comment "I didn't use the chatbot, no particular reason other than I was finding my footing in college but I will definitely use it this semester for guidance" (1BA22), aligned with my thinking of letting first year students settle in. Another student commented:

I didn't use it because I always just disregarded it and never took the time to look into it whenever it came up in my email inbox, to see what it actually was. Apologies for that. I would always flick over to the other emails that I knew straight away what they related to in terms of my college work/modules/lecturers. (1BA27)

This comment could be interpreted to suggest that students will focus on work directly related to their "college work/module/lectures" and as I am on leave and not familiar to these first year students, they ignored the correspondences. This perhaps is also a reflection of the low survey responses 27/150, an 18%

response rate for first years, but low student response rate is also evident in INDEx survey responses.

Interestingly, comparing results from the first year survey in cycle 3 to the initial survey to a group of second years in cycle 1 on how students regulate their learning (see Figure 5-2), the responses were similar. First year students find it hard to set goals, have planning, focus difficulties and easily get distracted. These distractions and focusing difficulties are also evident in previous data on mobile phone usage (see Figure 7-6). It is again encouraging that students are open to new ways of doing things, new software and can change and adapt when things are not going to plan (see Figure 7-11).



**Figure 7-11 First year student survey results regulate their learning**

Eight students stated that they liked getting notification each week with examples of what the chatbot can answer. 1BA15 commented: “found the post directing us to how to present live with captions very handy and the translator feature would be handy for language learning”. This use of notification directs and encourages students to check out a new competence each week. Moreover, students get notifications of “what is new” in different software every month to build awareness of how software evolves. Students were self-motivated to follow up the notification and use the chatbot. To ascertain what motivates students they were asked directly in the survey, “What motivates you to study?” and the responses were predominately “good grades” and “doing well in modules”. By asking students to reflect on their self-regulatory and

motivational factors for learning it enabled students to interrogate and verbalise their learning processes and motivations. Students, now, are more aware of distractions, influences, processes and how they can leverage the technology to enhance their learning. Students' use of the chatbot was also reflected in the software analytics that are detailed in the next section.

#### 7.4. Chatbot analytics

In the initial stage, the software afforded the ability to capture data in a twenty-eight-day timestamp of analytics, but this is extended to five weeks but still presents the limitation of not retaining older data to present a longitudinal analysis. Figure 7-12 displays the analytics for chatbot patterns of usage and students' engagement over five weeks of the semester in 2021.

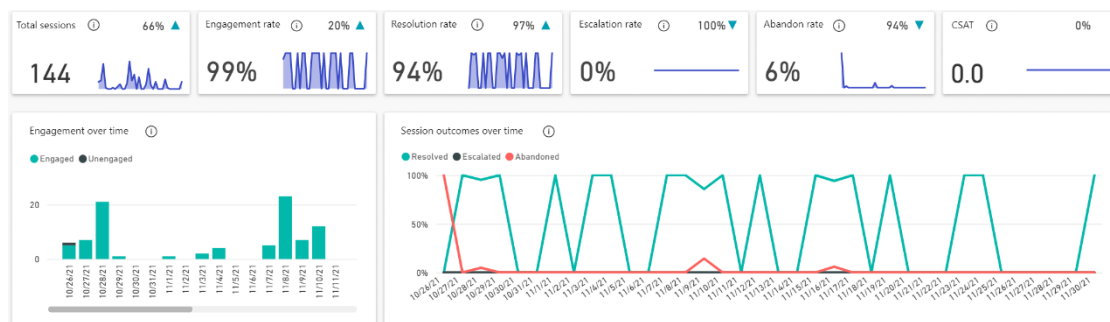


Figure 7-12 Chatbot analytics for five weeks of the semester in 2021

In this voluntary space, one hundred and forty-four different student sessions were undertaken in five weeks. Interestingly, drilling into these data, peaks align with date of posted notifications to prompt students to the resources available. For example, 10/27/21 aligns with this notification reminder (see Figure 7-13). This notification was commented on by SI4 and SI5.

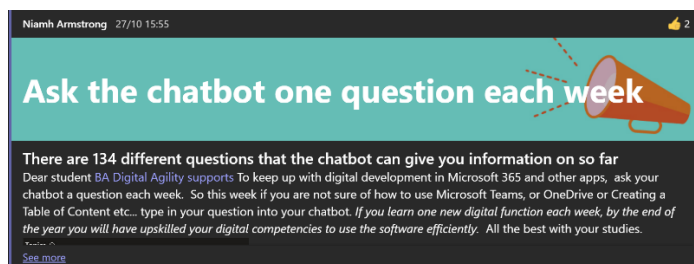


Figure 7-13 Notification of chatbot supports available

Another peak aligns with presentation assignments and a notification of presentation material available as mentioned in section 6.5 and Figure 6-13. Another noticeable insight is around an assignment due date that specifically required use of styles to present work. Additionally, data from the session logs show the different ways, vocabulary and keywords students asked in the chatbot questions, for example 'styles' is stated in Figure 7-14.

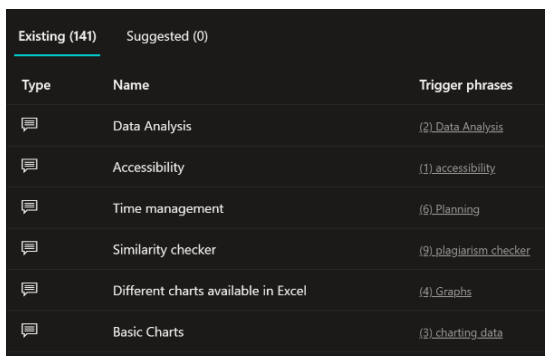
Format a document	2
gathering data	3
heading styles	3
help with styles	9
style help	1
style information	1
style stuff	1
styles	10
Styles Basics	2
styling a document	1

**Figure 7-14 Chatbot analytics session data questions on styles**

This different use of vocabulary to ask for help provides valuable insights into the importance of providing numerous trigger phrases in the designing of conversations to provide a timely answer to students. Delving into these analytics of what questions students asked the chatbot not only provides insights into students' needs but also identifies any questions that were not anticipated in the knowledge base of the chatbot. One example of a question that a student asked that was included in the chatbot redesign was "is there any quick way to format a list into a table on *Word* or *Excel*?" The detail of how to do this, with accompanying screenshots is now available on the chatbot. Another question noted from the session data was "*SPSS* for laptop" and this indicates the wide-ranging queries. *SPSS* statistical analysis software is not included in the chatbot to date but will be included in the future. The session insights present how students phrase their questions providing useful data to address RQ1.2: What digital questions were not anticipated and should be included in the chatbot knowledge base? and these analytics provided empirical evidence into what skills students needed support on, and also informed the redesign process which is outlined in the next section.

## 7.5. Chatbot redesign

The chatbot redesign targeted bespoke digital needs by communicating with students and academic staff to align with discipline needs. The constantly evolving digital needs of students at different stages in their degree need to be supported and I identify the chatbot as one solution. “Self-regulation of learning is not a single personal trait that individual students either possess or lack” (Zimmerman, 2002, p. 66) shows that my chatbot can play a role in promoting these strategies in the design. The chatbot can be used to promote awareness of SRL strategies, for planning, managing, and organising learning. To highlight this, I edited the *To Do* app to include information on how to set reminders and organise student tasks (see Figure 5-7). In addition, I added information that was requested for example for data analytic requirements and different chart features. This chatbot, now, can answer questions on one hundred and forty-one different topics (see Figure 7-15) and this specific knowledge base is aligned with students’ needs and academic staff digital requirements for their disciplines.



Type	Name	Trigger phrases
	Data Analysis	(2) <a href="#">Data Analysis</a>
	Accessibility	(1) <a href="#">accessibility</a>
	Time management	(6) <a href="#">Planning</a>
	Similarity checker	(9) <a href="#">plagiarism checker</a>
	Different charts available in Excel	(4) <a href="#">Graphs</a>
	Basic Charts	(3) <a href="#">charting data</a>

**Figure 7-15 Topics knowledge base**

This process is ongoing and continues to evolve in line with student and discipline needs. It involves awareness of what design principles can encourage students to be proactive in their own learning. The next section reflects on the development of the design principles.



## 7.6. Design Principles development

Initial design principles
Principle 1: important users or stakeholders involved in the development process
Principle 2: important that the chatbot presents a personality
Principle 3: importance of an initial message and clarity on what chatbot can do
Principle 4: importance of designing the conversation flow to guide users
Principle 5: supports include clear objectives, learning pathways and feedback
Principle 6: learning designed using iterative, structured but agile approach
Principle 7: build on existing learning and include new learning strategies
Principle 8: importance of user control
Principle 9: design aligns with Universal Design for Learning (UDL) values
Principle 10: clear and consistent language and standards
Principle 11: simple design and input
Principle 12: run on a variety of devices
Principle 13: handle dialog failure and end conversations gracefully

Table 4 Initial Design Principles presented

Table 4 offers the initial design principles' development. After reflection, redesign and observations on chatbot use, some of these principles were amended.

Principle 1, design is enhanced when an agile approach is used and all stakeholders share a common purpose (McKenney & Reeves, 2019; Mizuko et al., 2013). The inclusion of students who are the end users and academic staff who have digital expectations of students is an important factor in the process. Chatbot design and development must involve students and staff in the process - this addresses my RQ1: How can a chatbot be designed and developed to support students' self-regulated learning of digital agility?

Principles 2 and 3 on reflection can be combined as the initial message can present the personality of the chatbot and be clear about its functions.

Principles 4 and 10 can be combined, the conversation flow presents clear concise language (Bisser, 2021) and standards (Nielsen, 1994) and uses language or terminology of the discipline. This clear concise language and

standard are also embedded into the learning design Principle 5 in learning support that present clear objectives, levels and feedback (Gagné, 1985; Salmon, 2016).

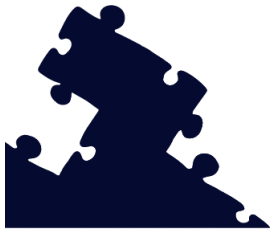
Principle 6, the importance of agile design to keep up-to-date with the changing digital landscape and discipline needs was evident in the findings when specific assignment requirements were added to the chatbot. This learning design could be merged with Principle 7 to provide explicit reference to prior learning, using real-world problems (Gagné, 1985; Merrill, 2002) and strategic SRL processes that allow learners to reflect and build the learning strategies that will cultivate their lifelong learning journey (Zimmerman, 2002). The findings on mobile usage and lack of use of technology to manage learning suggests promoting different SRL strategies will guide learners to have more efficient learning routines. Including a clear objective of transferability of learning was also evident from the findings.

In Principle 8, the importance of user control (Nielsen, 1994; Shneiderman, 1985) can be merged with Principle 12, the ability to run on a variety of devices or device independence (Microsoft, 2017). User control was mentioned by S1 during prototype testing referring to the close dialogue box option. The software was tested on a variety of devices and is successful bar the initial install on *Teams* as mentioned in the prototype findings.

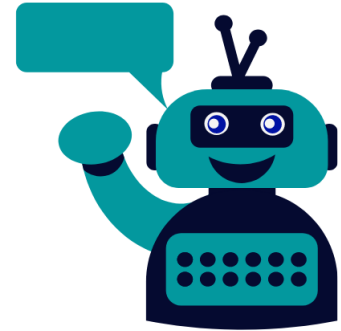
In Principle 9, design adhering to UDL principles (CAST, 2017) is essential to support the variety of learners and the diversity of their needs. The chatbots tangible space provides learners with access to a variety of different resources using different media when needed as well as promoting goal setting, self-regulation and management of learning. This empowers students to harness the variety of digital tools for their learning.

In Principle 11, the nature of a chatbot interface is a simple design and text interface and PVA facilitated this development including Principle 13's handling dialogue failure and end of conversation gracefully (Nielsen, 1994; Shneiderman, 1985). Giving users control, Principle 8 above, can be included with these principles.

In summation, these education chatbot design principles can be presented in six principles, as illustrated in Figure 7-16 and these address Research Question 3: What recommendations are there for designing and developing a chatbot to support students' digital agility?



## CHATBOT DESIGN PRINCIPLES



**Principle 1: Design is enhanced when an agile approach is used, and all stakeholders share a common purpose.**

**Principle 2: The chatbot should be clear about its functions in its opening message and this message should present the personality of the chatbot.**

**Principle 3: Chatbot design should use language or terminology of the related discipline, present clear learning objectives, a variety of levels and provide feedback.**

**Principle 4: Design needs explicit reference to prior learning, integration of real work examples and self-regulation learning supports with a clear objective of transferability of learning.**

**Principle 5: The chatbot should be accessible and adhering to Universal Design for Learning.**

**Principle 6: The chatbot should present a simple design, give users control, handle dialogue failure and end of conversation gracefully.**

Figure 7-16 Chatbot Design Principles

Reflecting on the chatbot design journey has reinforced the importance of awareness of the personas of your target audience and involving learners at every stage in the process. The learners are undergraduate students with diverse personas but with a common goal to learn. The chatbot must present an inviting opening message and be clear about what help it can provide, to make learners feel comfortable to ask questions. The knowledge base evolved with communication and collaboration with students and academic staff. Use of a simple interface that users can navigate adds to making learning seamless. Providing a variety of different resources, levels and media usage allows learners to take agency of their own learning. Empowering learners is central to UDL, to provide students with the tools they need to learn and recognise how they learn. Building students' awareness and cultivating students' self-regulation skills gives students this empowerment and agency to learn and become lifelong learners. This reflecting continues in the next chapter discussion that offers a reflection on the recurring themes in this research.

## **8. Discussion**

This chapter is divided in seven sections that retraces the salient themes in this study. The first section summarises the methodology of design-based research. Section two reflects on using self-regulated learning as a lens to support our students' learning. The next section considers again learning design followed by a section on the themes of agility, incorporating an open mindset, unlearning and continuous learning. Design principles are reiterated in section five and section six restates the conceptual framework. Finally, a brief summary is outlined. The chapter begins with a brief recap of the study.

The research investigates digital agility and uses the lens of SRL to foster students' learning. The study develops a framework for digital agility and design principles (RQ3) that underpin the development of the chatbot that is created to scaffold learning opportunities for students. The student voice is an important dimension in this research and their involvement is central to guide and shape the development of the chatbot. This voice shapes the knowledge base of digital questions that students may have during their undergraduate degree programme. The methodology of design-based research enabled cycles of feedback. The prototype cycle showed that students are positive about the chatbot and highlighted that SRL supports would benefit students. Cycle 2 brings to the fore the influential role academic staff play in fostering and shaping students' digital skills and their disciplinary digital requirements are included in the development. Cycle 3 reiterates the prominent role academic staff play in driving digital agility. Students' requirements for SRL supports and a variety of digital questions are reported. They were positive on the availability of a 24/7 digital question and answer chatbot. The next section reflects on the DBR approach used in this study.

### **8.1. Design-based research (DBR) approach reflections**

A design-based research (DBR) (Brown, 1992; Collins, 1992) approach presents an iterative process of discovery and opens opportunities to align design with students' evolving needs. The iterative, flexible, contextual and pragmatic research methodology (McKenney & Reeves, 2019; Wang &

Hannafin, 2005) was befitting for this study that necessitates constant updates to keep abreast with the changing technology landscape (Martzoukou et al., 2020; Park, 2017). In this research, the knowledge output is the digital agility framework, the design principles, an improved understanding of the needs of students in support of their digital agility and recommendations for practice and policy.

The DBR goal of impact on practice in conjunction with advancing theory also solidified this methodological choice (Barab, 2014; McKenney et al., 2006; McKenney & Reeves, 2019; Reeves, 2006; Wang & Hannafin, 2005).

“Theoretically inspired innovation” over “multiple iterations” (Barab, 2014, p. 151) that lead to generalisation in other settings, ensures that the research can be useful (Barab, 2014; Edelson, 2002; McKenney & Reeves, 2019; The Design-Based Research Collective, 2003). This research approach embraces real-world messiness with the integration of the theoretical perspective (Barab, 2014). The intervention design, the chatbot, is an important output as it provides students with a tangible solution that aligns with their digital needs and is situated in the pragmatics of digital use in a college. DBR cycles of designing, testing the design, evaluating and feedback from students and reflecting on the feedback, facilitates the resolution and refinement of any demerits over the course of study. The progressive refinement (Collins, 1992) of each cycle feeds into the next iteration and influences future learning space designs (Brown, 1992; Collins, 1992). DBR facilitated a culture of students giving feedback on their support needs and witnessing their feedback implemented, indicating to students that their input was valued. In addition, iterative collaboration with academic staff ensures their disciplinary needs are also included.

Finally, the outcome of DBR that it provides practical support or professional development to participants in the study (McKenney et al., 2006) was another influence in choosing the approach. In this research, the documentation of the process will allow other researchers a professional development opportunity and practical guide to develop a chatbot to suit their own context. These outcomes draw together design, theory and practice to provide valuable outputs from the research (Edelson, 2002).

To ensure robustness of the findings, DBR facilitates the triangulation of multiple data types and sources, offers checkpoints during the process to ensure reliability and aids the researcher in reflecting and redefining throughout the research and minimising bias in findings (Kennedy-Clarke, 2013; The Design-Based Research Collective, 2003; Wang & Hannafin, 2005). This research used INDEX surveys, students and academic staff surveys and interviews, and literature to facilitate triangulation. This variety of data affords a holistic overview of the research problem and solution. Koseoglu and Pazurek “propose that a unique approach to design-based research focusing on positive cases of effective design could be equally valuable” (2014, p. 92). Research projects could look at examples of what works well rather than projects starting from a problem (Koseoglu & Pazureka, 2014). This alternative use of DBR has the potential to lead to valuable insights and the potential to develop a collaborative community of learners. Further research could use positive examples from this study to develop a faculty community of learners to drive digital agility in the programme design of the degree. This next section explores self-regulated learning that is necessary for students to be successful in their studies.

## **8.2. Self-regulated learning (SRL) reflections**

SRL reflects the degree that learners are active participants in their learning process (Zimmerman, 2002). Students who employ a variety of different SRL strategies are successful learners (Anthonysamy et al., 2020; Ertmer & Newby, 1996; Yot-Domínguez & Marcelo, 2017; Zimmerman, 2002) and this extends to digital literacy (Anthonysamy et al., 2020; Greene et al., 2018; Peters & Romero, 2019). Using the theoretical lens of SRL affords the opportunity to take a step back before designing learning resources and drill into what SRL entails and be cognisant of how self-regulated learning strategies influence learning. This theoretical lens of reflection can help educators develop an alternative understanding of a situation and adapt “our interpretive frames” (Brookfield, 1998, p. 201). Keeping self-regulation processes in mind, before, during and after learning (Zimmerman, 2002) and being mindful in how technology can assist this learning is central to this study. As outlined in section 2.4, awareness



of cycles of learning, forethought - goal setting, performance - self-control and keeping to task, and reflection and evaluation (Zimmerman, 2000) is valuable to capture the support continuum (Corno, 2008). SRL is reported as necessary to be successful at university (van der Beek et al., 2020; Yot-Domínguez & Marcelo, 2017) but often students have deficits in their ability to self-regulate (van der Beek et al., 2020). Furthermore, the data bring to the fore deficient use of digital tools to manage their learning that aligns with work from Yot-Domínguez and Marcelo (2017) who investigated digital tools that university students used to assist their self-regulated learning. Student assignments can provide an environment for practicing SRL processes of planning, monitoring, controlling, and evaluating but with the effective use of software (van der Beek et al., 2020; Yot-Domínguez & Marcelo, 2017; Zimmerman & Tsikalas, 2005). Chatbot notifications can promote digital competencies and self-regulation processes (see sections 7.2 and 7.3).

The digital scaffolds synthesise a learning experience for students that promotes their curiosity to ask the chatbot other questions to evolve with changing software functionality (Winkler & Söllner, 2018). Students' curiosity to learn is witnessed by their use of the chatbot and exposure to new learning opportunities and automatic feedback is provided by their chatbot. The chatbot can support students' metacognitive processes in providing help for students to plan, organise, test, evaluate and revise the digital skills they acquire in their first year modules with the ability to extend these competencies throughout their degree. Students' motivation to learn and behaviour is also influential in learning success (Pintrich, 2000). Using the SRL lens is valuable as the chatbot is a voluntary space where students proactively find digital competency assistance. The chatbot encompasses a SRL environment that provides students with timely answers and sets them goals to improve their digital work with the aim to instil a lifelong learning digital culture (Peters & Romero, 2019). The chatbot presents general and discipline-specific strategies and this is enabled by reflecting on learning design as presented in the next section.

### **8.3. Learning design reflection**

Student involvement at all stages in the process ensures the chatbot is designed to guide students' digital agility throughout their degree. These students' eyes revealed what they liked and disliked about using the chatbot (Brookfield, 2017). Asking students to input their specific digital requirements and testing the chatbot encourages ownership of the chatbot (see section 6.3). Empowering students with skills and knowledge that incorporates initiative and control encourages students to become active agents in their learning. This in turn cultivates an excitement and genuine interest in developing a learning continuum of digital agility over their degree. The range of ability levels to inform the planning for each learning activity was considered. The chatbot's multimedia learning space incorporates text, links, videos and bite-size information, allowing students to study the material at their own pace and time so that they can choose the learning material that suits their needs and learning requirements. Central to UDL is the inclusion of a variety of media that assists students in their self-regulation process in addition to showing them how to adapt software to their needs. Another influential factor that facilitated a comprehensive design was communications with colleagues and understanding their perspectives (Brookfield, 2017). This opened the conversation and allowed sharing of options on students' performance using digital tools. Supplementarily, the agile development process of define, create, reflect, learn and redesign considers software innovations. The next section summarises the pertinent points of agility in relation to this study.

### **8.4. Agility - open mindset, unlearning and continuous learning**

My research reflects on the development of an agile mindset pertaining to students' digital use will help to prepare them for the constantly evolving digital landscape. A fixed mindset of "this is the way we always did it!" is counterproductive to building on their digital skills. Students need to develop an agile mindset of exploiting technology to save time and effort in their communication and collaboration. This will allow them to use these tools to have an efficient and effective digital workflow. Kowald and Bruns (2020) examined the ability of chatbots to expose students to new learning

opportunities. Their findings are echoed in this study that embeds a curiosity for learning by curating and adapting students' digital resources to mould their learning journey (Kowald & Bruns, 2020). The resounding opinion from my interviews with academic staff (see section 7.1) is that we want our students to become resilient and reflective learners who can adapt, change, manage their attention, plan and execute their strategy, to be successful in and outside an education environment (Anthonysamy et al., 2020). Anthonysamy et al.'s (2020) findings are echoed in this study and the inclusion of management of learning agility in my framework aligns with their research. All academic staff agree the importance of an open mindset, embracing change, having agency and being a lifelong learner (Becker et al., 2017). To mitigate the changing target of technology, the findings in this study suggest that we should strategically embed digital use into our modules to instil a digital agile mindset in our students. "Digital technologies are often a moving target where those lagging behind have to play a game of constant catch-up. In other words, the digital divide is never static" (Park, 2017, p. 52). To assist the digital catch-up, the findings in this study advocate the importance of a common language and academic staff sharing a common vision to drive an open and agile mindset.

The findings show a lack of awareness of how software changes and evolves by both students and academic staff. In order to mitigate this, an open and agile mindset needs to be cultivated. In this study, firstly, it is important that students' learning extends beyond operational digital skills (Johnston et al., 2018). For example, a digital operational skill is the ability to download an image and insert into a document (Anthonysamy et al., 2020). A digitally literate student brings awareness of appropriate use of copyright and creative commons permissions (Anthonysamy et al., 2020). A digitally agile student builds on the capabilities mentioned above and ascertains how new digital resources can be used to mine the metadata for historical, geographical and other identifiers that can connect images and their data. Remaining current with a variety of software developments extends research potential, for example use of a digital tool *Recogito*, an online platform for historical research, can mark 'strings' of place with maps and build relationships and networks in data (Recogito, 2018). The use of digitisation makes research more streamlined and provides different

visual insights and spatial analysis into research that without its use would not be possible. A digitally agile student is continuously seeking out a variety of software that can organise and even extend their learning and research capabilities. This sometimes involves *unlearning*.

The concept of unlearning to adapt to a changing technology landscape is necessary and well documented in the literature in the area (Anthonysamy et al., 2020; Park, 2017; Sierra, 2005; Wheeler, 2019). An example of learning, unlearning and relearning is the change in mindset from saving to a fixed device to saving to cloud storage. The mindset of constant connection and ability to access information from any device and ability to share and collaborate on documents evolves from this and the old understanding of fixed device use are obsolete. It is important that students look at their prior learning and build on this but also reflect on whether they use outdated or inefficient methods and harness the technology to gain a seamless workflow. The findings in this study reported many examples of use of outdated and ineffective practice. Section 7.1.3 reports on a variety of technologies students used to communicate and collaborate on their group work assignments that makes the process of group work, communication, collaboration, editing and sharing seamless. More importantly, this saves time and effort. This ability to change and unlearn as software evolves is the core of a digitally agile student.

My findings highlight that most students only use a small fraction of the tools that the software offers. What is more, a lack of awareness of how technologies continue to converge is evident in the data, in their use of multiple software to complete work when one tool would suffice. Also, awareness that the software we use is constantly updating necessitates a continuous learning cycle. This research provides systematic awareness into students' digital capabilities over their studies (Martzoukou et al., 2020). My digital agility framework builds the perception of agile learning cycles. This framework provides the thematic structure for supports the chatbot provides. The findings in this study reinforce the need for a learning space that prompts, guides, and teaches students to be aware of their digital agility and of the importance of continuous learning.

Encouraging a continuous cycle of learning aspires to prevent outdated use of technology.

Findings reflect that the chatbot question and answer knowledge base needs to be curated and constantly updated to keep abreast with changes in digital developments and disciplinary digital needs over the course of an undergraduate degree programme of study. The chatbot can be used to orchestrate students' digital learning progression and enables students to "learn-more" (Fryer et al., 2019, p. 286) digital competencies over the degree and not just revise prior competencies. To avoid a short-term novelty effect of using the chatbot, notifications that encourage a spaced out use of the chatbot could keep alive this initial interest (Fryer et al., 2019). As stated, academic staff have a prevalent role to play in driving students' digital agility by making explicit the digital competencies their disciplines require. This is achieved by incorporating these explicit requirements into the chatbot so that it evolves with changing disciplinary digital needs.

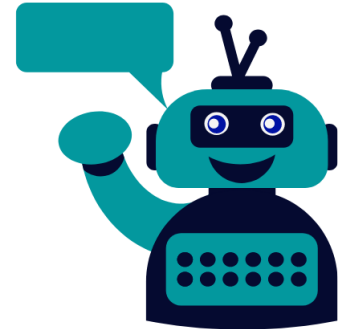
Fryer et al. (2019) note that chatbot developers need to work with educators to take into account the diversity of students and adjust to different competencies. The chatbot knowledge base includes digital agility core competencies (see Figure 7-1). Findings in this research are congruent with Fryer et al. (2019) and emphasise the importance of moving from a horizontal digital narrative of individuals working in silos to a vertical collaborative vision that is necessary to drive an alternative sustainable digital narrative (Flavin, 2017; Johnston et al., 2018). This aligns with the EUA's report findings on the importance of collaboration, partnership and communities presenting a shared drive to implement institutional change (Andone et al., 2022). Design principles guided the development of the chatbot as discussed in the next section.

### **8.5. Design Principles reflections**

The DBR process points towards thinking of design as a service with several dependents that are influential to its success (Barab, 2014). My six design principles are reiterated again with comments.



## CHATBOT DESIGN PRINCIPLES



**Principle 1: Design is enhanced when an agile approach is used, and all stakeholders share a common purpose.**

**Principle 2: The chatbot should be clear about its functions in its opening message and this message should present the personality of the chatbot.**

**Principle 3: Chatbot design should use language or terminology of the related discipline, present clear learning objectives, a variety of levels and provide feedback.**

**Principle 4: Design needs explicit reference to prior learning, integration of real work examples and self-regulation learning supports with a clear objective of transferability of learning.**

**Principle 5: The chatbot should be accessible and adhering to Universal Design for Learning.**

**Principle 6: The chatbot should present a simple design, give users control, handle dialogue failure and end of conversation gracefully.**

Figure 8-1 Chatbot Design Principles

Principle 1: Design is enhanced when an agile approach is used, and all stakeholders share a common purpose. Involving students and staff in the formulation of digital requirements in the design process is essential for the chatbot's success. The findings showed how the chatbot evolved based on this stakeholder input.

Principle 2: The chatbot should be clear about its functions in its opening message and this message should present the personality of the chatbot. Learners' experiences are enhanced when they understand what supports the chatbot provides and feel comfortable using the chatbot. Student feedback comments revealed they liked how the chatbot said "hi", and provided information of capabilities.

Principle 3: Chatbot design should use language or terminology of the related discipline, present clear learning objectives, a variety of levels and provide feedback. Learners' experience is enhanced when the chatbot is easy to understand and allows learners to choose their learning path. Student feedback was positive on the ease of use and the different levels of supports available.

Principle 4: Design needs explicit reference to prior learning, integration of real work examples and self-regulation learning supports with a clear objective of transferability of learning. My findings stress the importance of signposting prior learning and prompting, directing students to transfer their learning. For example, the use of the census data reports real work or real-world data for students to interrogate.

Principle 5: The chatbot should be accessible and adhere to principles of UDL. Empowering learners to adjust their learning environment to their specific needs is core to UDL.

Principle 6: The chatbot should present a simple design, give users control, handle dialogue failure and end of conversation gracefully. Findings display the ease with which the learner navigated the chatbot, and comments on the responsiveness of the chatbot emerged.

These principles were revised based on my experience with the chatbot and my findings from the study. The chatbot sought to enhance students' digital agility, and to this end a conceptual framework is used to steer this narrative. The next section focuses on my conceptual framework.

## **8.6. Conceptual framework reflections**

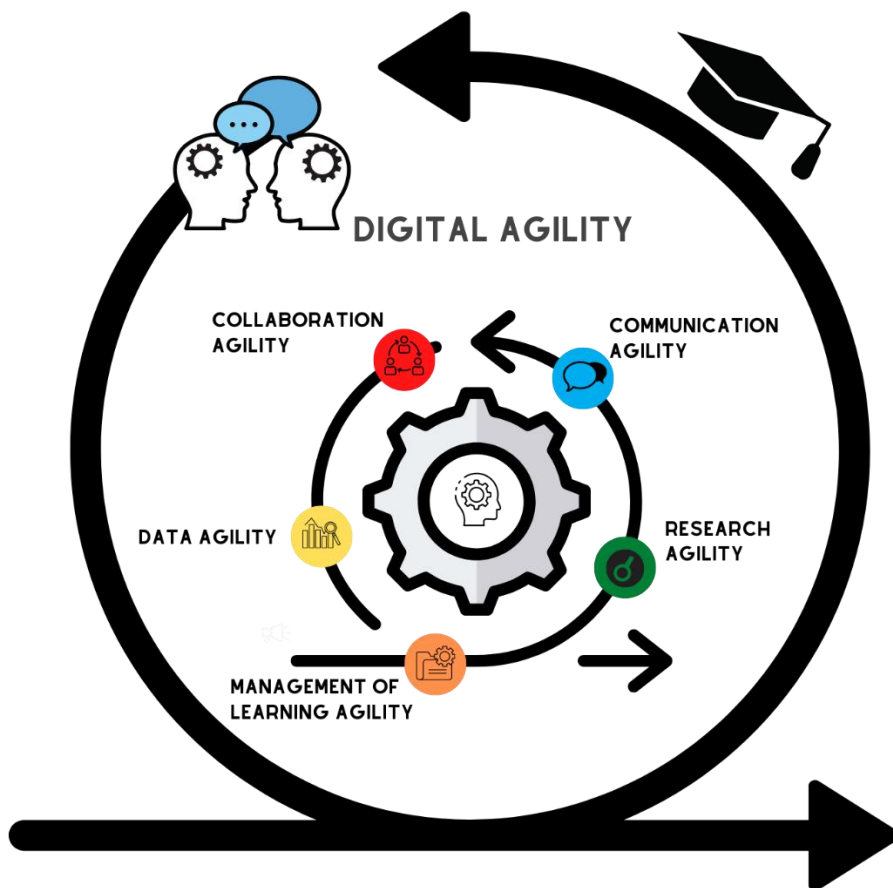
My conceptual framework presents five concepts:

- Learning management agility involves students using software to effectively and efficiently organise their learning. This also includes wellbeing, privacy and security and digital identity.
- Research agility involves students' digital capabilities in finding sources, writing clearly and critically, citing and referencing appropriately.
- Communication agility is the digital ability to present their assignment findings in a professionally presented document or presentation.
- Collaboration agility is the digital capacity to work in groups and use collaborative software effectively and efficiently.
- Finally, data agility is the ability to use data to present a story.

These elements are interdependent as students need to manage their learning tasks, then use research skills to document this learning and, depending on the task, use communication, collaboration and or data skills to present what they have learned. I contend that to achieve digital agility there is a need for consistency across modules, presenting a culture of digital agility and designing progressive, manageable competencies throughout the degree. To achieve this digital consistency, academic staff need to communicate, collaborate and present a common digital narrative of high expectations. This theme of programme design is supported from data from academic staff interviews in my study (see section 7.1.6). I am advocating the incorporation of a digital spine into our programme design, but this can only be achieved with the communication and collaboration of academic staff. The chatbot can support students over the programme with curated and orchestrated digital needs in tandem with the variety of discipline requirements. This holistic look at competencies demanded over a student's degree and incorporating these into



programme design develops a culture of learning that adapts to developments in disciplines that in turn develops an agile learning mindset.



**Figure 8-2 Digital agility framework updated**

The framework evolved from my findings. These changes aligned with disciplinary requirements of both students and academic staff. While the focus of this research is students' digital agility, my findings highlight that cooperation, collaboration, building awareness and developing digital agility in staff as well as students is needed to embed a digital spine into our degree programme. Figure 8-2 illustrates an updated representation of my digital agility framework presented in section 3.4 to include an icon representing staff communication and collaboration and staffs' digital agility. These findings align with research from the EUA's report: "an ethos of collaboration and partnership needs to drive institutional change" (Andone et al., 2022, p. 8). The context of an academic

organisation's digital needs that are constantly changing is represented by the agility symbol with academic cap icon surrounding the framework.

## **8.7. Summary of chapter**

This study exploits the iterative methodology of DBR to develop an understanding of the digital agility needs of undergraduate humanities students in the context of their academic disciplines. The systematic iterative design phases of DBR facilitate reflection and learning over the entire span of the research process allowing findings to shape the next development cycle. Furthermore, the project is evaluated in a real-world college setting, albeit in one undergraduate degree in one institution. Documentation of this research project informs pedagogical practices, by highlighting digital practices that support students' learning and to drive these practices education policy needs to align and reflect these changes.

Using different lenses of self-regulated learning is useful to be cognisant of firstly the awareness of SRL strategies on learning, then an understanding of different strategies that will enhance students' learning. Next, developing a learning persona of learners by asking students to think what they do to start their learning process captures their learning cycle and this highlights what students need to assist their learning. Using digital tools to drive SRL develops students' digital agility and in turn their SRL strategies. Moreover, self-regulation, flexibility, communication, collaboration, growth mindset, critical thinking and managing learning are among the competences that students need to develop continuously over a lifetime (Sala et al., 2020). These competencies are at the core of a humanities degree. Humanities degrees develop a variety of transferable competencies, students' critical thinking, analytical thinking, communication and collaborative skills and can strategically integrate digital agility into this competency mix. This mix of human skills of self-management, problem solving, working with people and digital skills, technology use and development are in demand for today's workplace (Whiting, 2020).

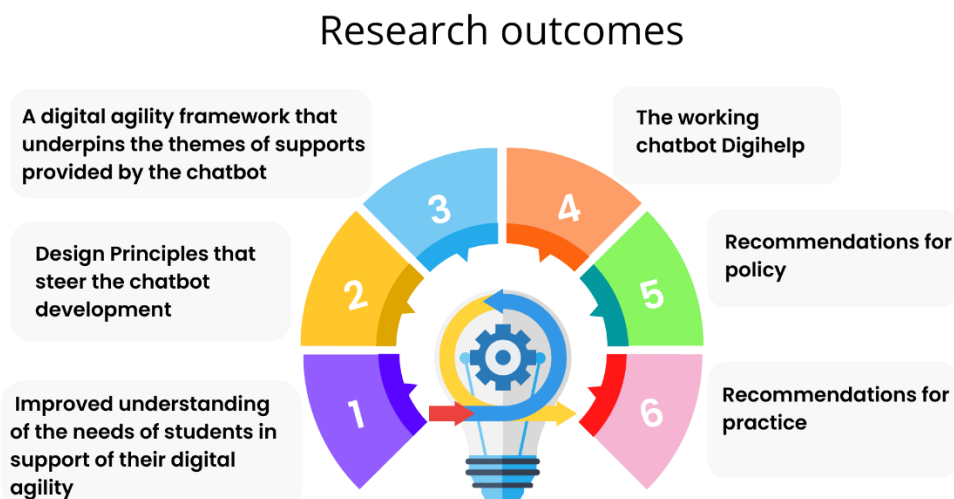
Learning design can strategically curate a set of skills and incorporating UDL elements empowers learners to adapt their learning environment to align with

their individual preferences. The awareness of that learning is a lifelong journey, needing openness to change and sometimes unlearning in order to progress is core being to an agile learner. Effective design can support the learning process and hence my design principles incorporate a diverse range of prior research to recognise in the development of the chatbot support. This environment was further enhanced by the digital agility framework that incorporates agility in managing learning, research, communicating, collaborating, and use of data. This represents the digital needs of students and discipline-specific digital requirements needed to succeed over the degree programme. The agility culture of academic staff and the context of an academic environment are important to drive this digital agile agenda (see Figure 8-2). The next chapter concludes this study.

## 9. Conclusion

This chapter is divided into six sections. The first section provides answers to my research questions and addresses how to support students' digital agility. Section two addresses findings pertinent to practice. The third section identifies how these themes have implications for education policy. The next section identifies limitations, followed by a section on recommendations for future work. The last section draws the study to a close. Before this, I provide a brief overview of the study.

This research spans a two-semester period in a Faculty of Humanities and produces six outcomes (see Figure 9-1) and the first three are contributions to knowledge (see section 1.8). One, an improved understanding of the needs of students in support of their digital agility outlined in the three findings chapters. Two, design principles that steer the chatbot development, see Figure 7-16. Three, a digital agility framework that underpins the themes of supports provided by the chatbot, see Figure 8-2. Four, the working chatbot, see section 4.6.2.2. Five, recommendations for policy, see section 9.3. Six, recommendations for practice, see section 9.2.



**Figure 9-1 Research outcomes**

Chapter one introduced the rationale and background of the study. Chapter two provided an extensive literature review on the digital narrative, student experience, self-regulated learning, learning agility, chatbot overview and

design, and learning design. Chapter three narrated the development of the conceptual framework. Chapter four outlined the research approach design-based research. Chapters 5, 6 and 7 addressed the findings from the three cycles in this study. This was followed by chapter 8 that discusses the recurring themes and finally chapter 9 brings the study to a conclusion. The next section addresses the research questions.

### **9.1. Answering my research questions**

This research investigated digital agility and sought to explore how a chatbot can be used to provide supports for students' self-regulated learning of digital agility. The study gathered students' feedback using the chatbot, discipline-specific digital needs from academic staff and ascertained recommendations for other researchers to develop their own chatbot. The findings show that they turn to the chatbot when they need assistance and the chatbot's immediate reply allows students to seamlessly continue with their learning tasks. Findings display the complex and numerous interdependent factors, specifically national and international policies that are drivers of digital development (see section 2.2). Other factors include general digital competencies (see subsection 3.3) and specific disciplinary needs (see section 6.2 and section 7.1). Addedly, the practical relevance of this research is high, as communication with students in the design-based research process (see section 4.6) took into account student preferences over three cycles (see subsection 4.6.5) and transforms their interactions with a chatbot that assists their learning journeys. The research questions explore these digital requirements.

Analysis of the findings revealed insights to address the research questions. Research question 1 poses, how can a chatbot be designed and developed to support students' self-regulated learning of digital agility? The evidence emphasises the importance in giving students control to guide the chatbot's path to meet their digital needs. Equally, communication with academic staff is also important as their assignment requirements are a major driving factor in students' use of their digital skills. This impact of academics driving the digital agenda is captured numerous times in the findings (see section 6.2 and section 7.1) with their essential role in shaping students' digital capacity through

discipline-specific competencies (see subsection 7.1.4). This reiterates the importance of capturing digital skills for each context and anchoring and situating digital skills into disciplinary practice (Brown, 2017). The findings suggest that if students do not perceive that professional presentation of digital work is necessary for their assignment, then the majority of students only demonstrate basic digital skills. This reinforces the need for communication and collaboration among academic staff and to present to students a shared expectation of best practice in the presentation of their assignments. This importance of communication with students is continued in the design and development process and this helps to address research question 1.1.

Research question 1.1 asks: What perceived benefits and limitations did students present in the design and development process? Students display positivity about having a 24/7, easy to use digital assistant that answers their questions immediately and with anonymity as cited in section 6.3. The initial challenge of uncertainty in how to use the chatbot was addressed by creating a video to guide learners in how to use the chatbot. Another challenge was that students need to be made aware of the range of help that the chatbot provides. Notifications now remind students. Findings reveal that when students receive notifications that assist them in completing assignment work, this drives them to the chatbot (see section 7.3). These notifications consequently can turn into an enabler to use the chatbot which is one factor to answer research question 2.1, that is detailed next.

The prototype testing highlighted that the feature to rate their experience on using the chatbot needed to be removed, as detailed in cycle 2 (see section 6.5). Another limitation presented was on the number of available topics the chatbot could answer. In the initial prototype, this was eighteen topics; in cycle 2 this was scaled up to one hundred and two, and cycle 3 features one hundred and forty-one different topics for students to get answers to. The chatbot constantly evolves based on students' and academic disciplinary needs, and with technology updates. One example of technology change added to the chatbot is information on the Rehearse with Coach feature in MS *PowerPoint* (see section 6.5).

Research question 1.2 poses, what digital questions were not anticipated and should be included in the chatbot knowledge base? To gain a holistic understanding of the range of questions, the input from students and academic staff is essential in the knowledge base progression. These findings led to actionable insights that optimise the variety of topics, for example, recording of presentations, inserting a screenshot, organising data in a combination chart (see section 6.4). Aids to manage student learning and self-regulation strategies are purposefully included to instil this strategic mindset to use technology to make workflow more efficient and effective. These are highlighted to students with notifications.

Timely notifications that I sent to students to help with their assignments were perceived positively in my findings (see sections 7.2 and 7.3). Additionally, the variety of topics available also presents positive perceptions to address research question 2: What are the students' perceptions of the chatbot for supporting their digital agility? Examples showcase the transferability of digital use across disciplines. Research question 2.1 asks what factors will enable students' self-regulation. Findings stress students' deficient use of technology to manage their learning (see section 7.1.5). The inclusion of technology that can assist self-regulated learning strategy builds awareness and makes it explicit to students of how they can harness software, for example, the use of the *To Do* app for time management, planning and workflow. These strategies and knowledge can mitigate against factors that hinder students' self-regulation, posed in research question 2.2.

Challenges in focusing when they have difficulties with the task and the fact that they are easily distracted are factors that hinder students' self-regulation; this addresses research question 2.2. These findings iterate the need to provide students with help to stay with the task. To counteract these hinderances, the chatbot can guide students to stay on task and weekly notifications can flag tools that can assist their learning, as commented by students SI4 and SI5 in section 7.2. The chatbot design evolves with student feedback over each cycle of use. This student input also facilitates reflection on the development of design principles to address research question 3.

Research question 3 poses: what recommendations are there for designing and developing a chatbot to support students' digital agility? Section 7.6 offers a summary of principles that evolved with insights and experiences in this study. User involvement and building a picture of the persona of this user is reported. Building this persona keeps the users in mind, their use of language, expectations and their specific needs. The importance of initially gaining students' attention and retaining this attention is one factor that influences the success of the chatbot. Correspondingly, presenting students with learning strategies that assist and motivate them will encourage their lifelong learning journey. The findings to the research questions crystallised my thinking and shaped the next section's influence on practice.

## **9.2. The main contribution of my research to teaching practice**

One contribution to practice is the production of a practical guide that will assist other educators with professional development to replicate the research. Additionally, findings in this study highlight the need to make explicit communication of transferable skills to students. Findings from academic staff surveys and interviews indicate undergraduate students in this study did not transfer the knowledge acquired in their information technology modules (see section 1.3) to future modules. This quote corroborates this: students "did not transfer learnings from one module to another module" (AS3). This lack of transfer is surprising as students are continuously reminded of the necessity to present professionally designed documents for all academic disciplines. In addition, real-world examples from different disciplines, for example historical and geographical data from the censuses, are used to highlight data competencies. This lack of transfer reinforces my argument for the need to have an ongoing "go-to" space for students to ask digital questions over the course of their degree. The findings do present a *proviso* that students will use the chatbot if guided with notifications and reminders of competencies they need to successfully complete their assignments.

Additionally, the findings align with Johnston et al. (2018) on trans-disciplinary exploration of digital work and the role academic staff play in communicating and sharing these practices. Discussion is necessary among academic staff on



the triangle of learning, technology and assessment and how as educators we share commonalities within disciplines and between disciplines. Students often appear to be challenged with the concepts of trans- or inter-disciplinary studies. Hence, explicit direction and guidance may be helpful. The findings in this study advocate looking at programme design and opening a conversation on designing strategic digital transferable skills with a view to emphasising their relevance and demonstrate how these skills map to each discipline (Johnston et al., 2018). Johnston et al (2018) incorporates “digital participation, information literacy, curriculum and course design and learning environment” (p. 42). My research developed a digital agility framework that supports digital participation and literacy. In conjunction, this digital agility framework can frame curriculum and course design and set the themes for the chatbot learning environment. Considering one element of my digital agility framework, data agility, programme design can question for example, how perhaps can we embed data, expose students to data and data literacy in all modules? How can we embed awareness of where data come from? Students need to question this; how valid are the data, how were they collected, are there biases? How are they used, interpreted and presented? From personal experience teaching students, if students can address these questions, they will acquire a data agile mindset.

The chatbot evolves and has potential to present a curation of learning materials in response to student needs (Villegas-Ch et al., 2020; Zawacki-Richter et al., 2019). Students can consume bite-size assistance in the workflow of their academic learning journey. Student needs are triggered by the demands of assessment that require specific digital requirements, for example, a recording of presentations. The results from the poll displayed in Figure 7-5 (see section 7.2), indicates how influential assignments are in directing and encouraging an integrated digital skill set. This turns the spotlight on how influential assignment design is in creating opportunities to apply what students have learned (van der Beek et al., 2020) (see section 7.1) and can be used to promote positive student engagement.

Before designing assignments, it is important to reflect on the current situation described in this study. As previously mentioned, students received digital

competencies in first year modules, and I propose these competencies need to be embedded in their assignments. If academic staff have high expectations and provide signposting to prior learning, this helps to create a culture of learning and digital agility. Results from students (see section 7.2), indicates that students will use digital skills if they are explicitly asked to do so in assessments. Empirical evidence of this is acquired from students' interviews, the outcome displays only one out of six students would use digital skills in their assignments unless asked specifically (see Figure 7-5). From these data it is not unreasonable to argue that students are assessment focused and privilege some assignments with professional digital use over others. Educators need to leverage this to interweave digital expectations into all assessments. This research emphasises that the academic staff community is influential in fostering and shaping these transferable skills. The findings echo research from Peters and Romero (2019) in promoting a flexible learning culture by guiding students in their assessment instructions and specifically reinforcing connections for students to learn new skills and grow. "Designing connections and building lifewide awareness" (Peters & Romero, 2019, p. 1740) echoes this, but to achieve this connected goal, there needs to be a common voice from academic staff. This study reports the importance of a connected thinking approach to programme design and having a common voice to foster sharing of ideas and practices. I recommend developing a digitally agile academic staff community of learners that share a common voice to strategically embed a transferable digital skill set into the programme, their modules and assessments. I also recommend both students and academic staff are involved in the chatbot's knowledge base development. The findings supported how a chatbot offers a sustainable, supportive, student-friendly solution to some of the challenges mentioned earlier in section 7.1. Digital agility can be shaped by implementing a faculty-wide creative digital vision, connecting thinking and strategic scaffolding of supports to foster students' digital agility over the degree.

Taking a personal reflection on the variety of digital skill sets I have used, for example mind maps, multimedia posters, portfolios, video diaries instead of examinations for the last twelve years, I did get an initial push back from

students as they were taken out of the comfort zone of examinations. I am used to push backs from students, for example when I introduced *Microsoft Teams* instead of *Moodle* as a learning space for second year modules in 2018, some students were not happy to be moved out of their comfort zone of *Moodle*, but I was contacted numerous times over the last few years on how beneficial it was to know how to navigate *Microsoft Teams*. I contend that students need to be pushed and when they clearly see the reasoning behind the introduction of different technology, for example *Microsoft Teams* being an industrial standard that they can use outside college work, most embrace learning these technologies. I am conscious that some software documented here will have evolved, but this reinforces awareness of the need to stay digitally agile. As long as I continue to teach, I will continue to learn, explore and push the relationship between technology, pedagogy and creativity and drive students to become digitally agile members of society. There is a need for education policy to reflect and promote practice and this is discussed next.

### **9.3. The main contribution of my research to education policy**

Findings in this study highlight that academic staff and disciplinary practices play an important role in nurturing and integrating learning strategies into programme design and across the learning continuum (Johnston et al., 2018; Peters & Romero, 2019). This study's digital agility framework provides a footprint to academic staff to embed digital agility into their module design. This needs alignment with strategic planning and curating of support services for students' digital agility. The development of a digital ecosystem is central in student learning (European Commission, 2020). Education leaders aspire to find sustainable solutions to improve the student experience (Flavin, 2017).

Findings in this research reveal the need for a holistic leader with education and technology insights to drive a strategic creative vision. Having an institutional or faculty champion is imperative to drive digital agility in an organisation. Harnessing innovative staff members as role models to drive change is reported in recent research from the EUA. "Harnessing the early adopters, amplifying their influence, augmenting their innovations so they can be multiplied, and enabling them as ambassadors of change" (Andone et al., 2022, p. 6). This

report “asserts that everyone needs to be seen as a valuable micro-leader with the ability to influence the work environment and, to a further extent, the institution and community with which they interact” (Andone et al., 2022, p. 4). A distributed leadership that promotes, rewards and enables innovation in best practice and encourages communication and collaboration in the strategy development process is more likely to be successful (Andone et al., 2022). From my experience, it is imperative that education leaders do not take a myopic stance but seek to be farsighted in taking all stakeholder insights into account in this changing landscape.

I recommend as a faculty community we need a coordinated strategic digital vision and agenda for our programme (Pettersson, 2018) and embrace the value of cooperation with different disciplines (Peters & Romero, 2019). Results, for example, show how two disciplines require first year students to gather and present data in chart format (see subsection 7.1.4). Two students commented that they did not know this at the time that the chatbot had the answer. A joined-up and strategic data vision across academic staff would provide students with a common data narrative and competencies enhancement (Johnston et al., 2018). Data agility is an element of this study’s conceptual digital agility framework (see Figure 8-2). This data-driven lens would foster a joining up of the dots and bring cohesion for students to transferability and trans-disciplinarity of data literacy. Then, when needed for their undergraduate dissertations, students could be signposted to prior learning and directed to the chatbot. This digital strategic vision needs to be agile to keep current with the evolving digital landscape.

This research suggests that incorporating agility into the narrative is influential in the progression of students’ competences, and students’ need to be digitally responsive, to be current in the evolving landscape. Student learning is a continuous cycle of “do-reflect-learn” (Hayward, 2018, p. 34) as depicted in section 2.5, and it is important that students learn from mistakes, embrace feedback, are flexible, adaptable and have the ability to change (De Meuse et al., 2010; DeRue et al., 2012; Hayward, 2018). Embracing failings and learning from mistakes is a change to the learning culture in education but can be

fostered by continuous feedback on students' work. I recommend including in teaching and learning feedback policies the role learning from mistakes plays in the learning cycle. This can be further enhanced with the provision of a sustainable digital assistance to foster digital competencies and use of digital tools to support self-regulation strategies with the aim of building students' awareness of how they can control and influence their learning.

In aligning with the leadership vision, all staff must embrace an agile digital culture. As hypothesised by Pettersson (2018), this may involve changing digital practices in an organisation, but this may be necessary to present a digital agile narrative on the ground. This digital narrative of the need to foster a skill set of competencies and learning is at the fore of numerous educational reports and policies (Department of Education, 2018; European Commission, 2020; Redecker, 2017; Sala et al., 2020). From personal experience, finding a solution is more pertinent to keep students up to date with this evolving landscape. A chatbot is one solution that could be leveraged to build on the capacity of human resources by diverting common and frequent questions to provide a timely response to questions (Winkler & Söllner, 2018; Wollny et al., 2021). Targeted scaffolds accentuate the full functionality that technology can provide to students across the variety of disciplines. This ongoing updating, communication and collaboration with stakeholders will ensure a usable and sustainable solution in the future. The next section segues to consider limitations of this research.

#### **9.4. Reflection on limitations of the study**

This section will discuss limitations in the time span of this research in one degree and institution. One limitation is the choice of the development environment not being open source. Additionally, this research did not look at gender factors, social, network or collaboration insights.

This research is confined to one degree programme, a humanities degree in one institution during one academic year. If it followed students' progressions and tracked students' digital needs as they evolve over the four years of their degree, a longitudinal lens of students' digital agility progression from first to

fourth year would emerge. This longitudinal lens would provide rich data, but it was not a feasible timeline for this doctoral research. No measurement is taken on the extent to which students adapt their behaviours in using digital technology. This could be observed by academic staff over the different years with reflections on previous digital use in their assignments. The inclusion of other humanities degree students in other institutions would also present a wealth of data but logistically getting access to another institution, its students and to an external IT system would be very challenging and potentially time consuming. Furthermore, the volume of data would have been unmanageable. The inclusion of research into the culture of digital use, organisational culture and institutional strategies are also not included for two reasons – firstly, for it to be comprehensive, all the college community would need to be included and this again would present an unmanageable amount of data for this specific research. Secondly, this inclusion would dilute the focus from our BA students and divert attention to potential college community requirements.

A common limitation with intervention development is the focus on one platform, but other platforms have similar software apps available with similar developer interfaces. Hence, the development process would be similar. A research limitation that I am very aware of is not using an open source application for the development space. This process would involve asking our IT services for their input and adding to colleagues' work was not considered. In addition, I would not have had complete control over the chatbot creation, deployment and all the project management.

I purposely focus on text-based message chatbot interface, but two limitations in the chatbot development environment could be perceived. I did not include a voice-enabled system and, while the addition of voice would add to usability, accessibility and functionality of the system, the counterargument for not including voice is underpinned by students' preferences to text instead of voice as illustrated in Figure 7-7. It is worth pointing out the PVA developer environment has evolved over this study and plans are underway to include voice functionality. Furthermore, chit-chat, small-talk and humour were not included in the design and this inclusion could potentially enrich the

conversation output (Jain et al., 2018). I did not use an anthropomorphised agent, or “embodied conversational agent” (Hobert, 2019, p. 261; Jain et al., 2018; McDonnell & Baxter, 2019), or agents that can be “visualised using artificial bodies” (Hobert, 2019, p. 261). An artificial body would facilitate an avatar that exhibits human expressions and gestures (Hobert, 2019) but this study aligns with contemporary research in preferences for simple interactions as opposed to a complicated avatar chatbot (Ciechanowski et al., 2019). I did not consider any gender stereotyping that students may have placed on the chatbot (McDonnell & Baxter, 2019; Toader et al., 2020). Another limitation of the study is not considering social factors or the theory of computers as social actors (CASA) that may develop when students interact with the chatbot (McDonnell & Baxter, 2019; Toader et al., 2020). There is evidence of this emerging from the *Microsoft Teams* space in student conversation posts, but this research did not follow up on the possible effect of student collaboration, or communities of learners or new networks.

Another limitation is, while the main advantage in having anonymous survey data is to receive open feedback, it restricts follow-up on interesting comments from students and academic staff. Also, the survey did not collect gender data which may present interesting insights. For information, the student interviews and academic staff interviews had a 50:50 balance of males and females, but the influence of gender was not analysed. These limitations open the potential for future work which is discussed briefly in the next section.

## **9.5. Possibilities for further work**

This section looks at further projects that could explore the limitations addressed above, reflects on the impact for my personal practice and on an organisation vision, and explores the potential for Erasmus+ project work.

### **9.5.1. Follow up of limitations**

Research could follow the learning progression of students over the four years of their undergraduate humanities degree. The research could be expanded to other degrees over a longer timeline and in other institutions. Further research

into organisational culture aspects of introducing a digital spine or digital strategies across an organisation could be studied. The consideration of gender, social economic factors and networks that develop from using a chatbot could be researched. The use of a different developer environment with the inclusion of chit-chat and humour, voice or avatars could provide interesting assistance for students. These future projects would progress the use of the chatbot in education settings. The next section explores outcomes for the researcher's personal practice.

### **9.5.2. Outcome for the researcher's personal practice**

One outcome of this research for my practice is that I will create learning diaries for all students and ask tutors in my first year modules to get students to reflect immediately after the digital competence they cover each week, by writing or recording a statement on what they learned and where they can use this work again in other modules. This would be reinforced by academic staff sharing a common digital vision and explicitly including digital points to include in their assignment instructions and explicitly remind them of competencies they gain in the first year. This could be further advanced by encouraging students to continue to record their digital work over their degree and use this work as a CV for life, that constantly evolves, adapts and changes. This journaling of their digital learning journey would reinforce in students their digital agility and make explicit their transferable skills. This could be included in their off-campus placement assessment work and credited. In their studies, students gain investigation and research skills, writing skills, time management, IT skills and demonstrate creativity working on portfolios and students need explicit reminders of these competencies. Future employers look for IT skills that students attain and students could provide an overview of their digital journey bringing attention to their commitment to lifelong learning and learning agility. The next section explores institutional considerations in developing their own chatbot.



### 9.5.3. Organisational digital vision

The use of a chatbot as a question and answer support can be extended to a college-wide student base and other degrees, but this needs a curated and strategic input from other disciplines to align with their programme needs. Administrative services could leverage chatbot technology to provide 24/7 assistance (Pérez et al., 2020), for example, a chatbot could also be used by our academic learning centre to provide timely answers to technology-enhanced learning questions. To drive digital agility, the institutional digital narrative should be critically analysed (Flavin, 2017; Pettersson, 2018), as digital capabilities are very transparent. As an institution, there is a need to present to students a continuous digital development landscape and best practice of digital use through the college community (Flavin, 2017). To further research this digital narrative, the importance of a strategic digital vision at institutional level is stressed (Flavin, 2017; Pettersson, 2018) to create an ethos of digital agility across the college community.

The college community, for example, could use a shared calendar for student digital usage for each year group and semester. This calendar could provide an overview of a digital timeline of needs that opens opportunities for digital discussions among academic staff. This also provides a faculty community insight into digital needs that could facilitate more targeted digital planning for students. This synergy of cooperation could serve to bring to the fore commonalities that might lead to transferable learning. The chatbot provides microlearnings and these could be accredited or documented by providing students with micro-credentials of their learning.

I propose a critical look at all organisation communication channels and present in all correspondences a narrative of best practice in digital use, for example the use of always referencing image sources. Communications present the brand and ethos and narrative that aligns with the organisation. To keep current, consideration of software developments could be leveraged to deliver a more targeted message. I propose looking at the *SharePoint* portal and to use it in conjunction with *Microsoft Teams* and integrate *Viva Connections*, *Viva Topics* and *Viva Learning* that have the potential to harness college-wide expertise and

knowledge and send targeted discipline-specific interests to students. Additionally, this could also be used to foster a learning culture than enables everyone to develop competencies to support their workflow. Another option is to create a college-wide *Yammer* space for digital agility that is constantly updated with digital developments. To gain international insights of best practice digital use, the opportunity to research and collaborate with other education institutions is recounted in the next section.

#### **9.5.4. Potential Erasmus+ research opportunities**

This research is the continuation and beginning of a longitudinal study to develop digital agile students. Work is in development to apply for Erasmus+ funding that will allow the researcher to collaborate with other education institutions and share and research experiences (European Commission, 2019) of using chatbots in teaching and learning. Along with this project, I will apply for Erasmus+ funding to undertake a study visit to European universities (European Commission, 2019) that are using chatbot technology and this visit will open up new opportunities for research and collaboration. The next section concludes the research.

#### **9.6. Conclusion summary**

This research has revealed that students were positively disposed to the chatbot's 24/7 anonymous availability. It unveiled how academic staff are enablers and can drive digital agility and ultimately shaping the trajectory of digital work in their modules. The influence of assignment design in driving learning and instilling a lifelong learning mindset is identified. Continuous communication and collaboration are needed to keep an agile narrative among academic staff and strategic leadership at all levels plays a significant role in this community network (Wheeler, 2019). Consequently, I emphasise the need for a strategic digital vision to curate, drive, shape and nurture students' digital agility over their degree. To achieve this, the learner needs to embrace agility to address the changing digital landscape in repeated cycles of learning. This research highlighted the importance of an agile mindset, learning, unlearning, and learning from mistakes and relearning. Furthermore, student involvement in

the design and development of their chatbot empowers learners to control their learning by equipping students with digital supports they can use to adapt to their specific needs. The chatbot ensured a flexible provision of support to upskill and reskill, learn, unlearn and relearn. Looking at this study through Brookfield's four lenses, autobiographical, the students' eyes, our colleagues' experiences and the theoretical literature facilitated a holistic understanding of the findings (Brookfield, 2017). While the research presents limitations illuminated above, these limitations can be overcome in future studies. Overall, the positive outcome of this study is that digital agility can be driven and enhanced by a leader curating a digital strategy and leveraging the collective wisdom of students and academic staff to ascertain the variety of digital requirements over the course of a degree. In conclusion, it is imperative for educational organisations to continuously evolve and keep digitally agile and lead students along this agile journey of learning and discovery.

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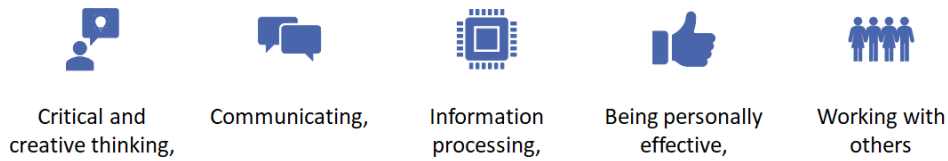
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Zumbrunn, S., Tadlock, J., & Roberts, E. D. (2011). Encouraging self-regulated learning in the classroom. *Metropolitan Educational Research Consortium (MERC)*.  
[https://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=1017&context=merc\\_pubs](https://scholarscompass.vcu.edu/cgi/viewcontent.cgi?article=1017&context=merc_pubs)



## Appendix 1 Education continuum themes

### Senior Cycle key skills



### Junior Cycle key skills



### Primary priorities



### Early childhood themes



Note at primary level these priorities are in the process of redevelopment and a draft consultation document is in progress. The themes under consultation are “Being an active citizen, Being creative, Being a digital learner, Being mathematical, Communicating and using language, Fostering wellbeing and Learning to be a learner” (NCCA, 2020, p. 7).

## Appendix 2 Student survey

### IT supports over your BA degree

This short form is to get information on what IT software support questions you would ask a chatbot. This research will provide two uses; one for you that will provide you with 24/7 digital supports over your BA degree and secondly provide me with data for my PhD. Thank you for taking the time to complete this survey, it will allow you to drive what supports you want the bot to provide. take care Niamh

...

\* Required

1. Where do you go to upskill your digital skills? \*

Enter your answer

2. What digital questions would you like the chatbot to answer? \*

Enter your answer

3. The bot is in development but what comments have you on using the bot to date? \*

Enter your answer

4. Describe your workflow and the technology you use for a written assignment? \*

Enter your answer

5. Describe your workflow and the technology you use for a group work assignment? \*

Enter your answer

## Appendix 3 Academic staff survey

### Digital Agility in the BA

This form will gather information anonymously on the digital work you expect from your students throughout their degree. I will use this data and insights for my PhD by including your specific digital discipline needs into my chatbot development that will provide our students' digital supports over their degree. Ethical clearance was approved by MIREC A20-032 and from Lancaster University. Thanking you for your time on completing this. If you have any queries, please do not hesitate in getting in touch with me. Thanking you, Niamh



\* Required

1. What digital questions would you like the chatbot to answer in order to help your students? \*

Enter your answer

2. What new digital technologies have you used in recent times that have transformed how you do your work? \*

Enter your answer

3. What prerequisite digital skills do your students need to successfully engage with the material in your modules? \*

Enter your answer

4. Ideally, what digital competencies do you wish your students to have in order to enhance their learning experience? \*

Enter your answer

5. At present, how do you support and enhance the digital competencies of your students? \*

- Assume they know the software
- Provide screencasts explaining the digital tool
- Provide written instructions explaining the digital tool
- Guide them to online videos and resources to a particular tool
- other

6. From your perspective, how would you describe a digitally agile student? \*

Enter your answer

7. Have you any other comments or recommendations that you would like to include?

Enter your answer

## Appendix 4 Student survey mobile usage

1. How many times did you check your mobile phone in the last hour?

0-2

3-5

6-9

10-12

12-15

>15

2. What is your most frequent activity?

sending text messages

taking photos

updating Instagram or other apps

voice calls

search

3. What devices, phone, tablet, laptop, computer... do you use?

- Mobile
- Mobile, Tablet
- Mobile, Laptop
- Mobile, Tablet, Laptop
- Mobile, Tablet, Laptop, Smart Watch
- Mobile, Tablet, Laptop, Smart TV
- All and other

4. Do you like using mobile tools in your learning



5. How would you rate your Skills

	Very Confident	Confident	Neutral	Little Confidence	Not at all Confident
I am confident using most Office 365 software	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel confident about my ability to present information to others	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident working in groups	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident asking questions in lectures	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident in my ability to manage my time	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

6. Digital awareness

	Always	Very Often	Fairly often	Occasionally	Never
I keep track of my online identity ( google myself to see what information is available)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I edit or remove information online frequently	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I check privacy settings on apps that I use	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am aware of others when I post information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

7. Who influences you the most

parent/guardian/family member

friends

educator/work leader

media online

8. Do you double check your news sources

Yes

No

Sometimes

9. What web app do you use the most frequently

Enter your answer

10. What web tool would you like to learn / use more

Enter your answer

## **Appendix 5 Student interview questions**

Can you share your screen and explain what you are doing and why as you navigate through the chatbot?

What features did you find useful?

What features did you not find useful?

Have you any suggestions that would improve your use?

Is there anything else you would like to add that I did not ask?



## **Appendix 6 Academic staff interview questions**

What digital development has transformed your discipline in recent years?

What software do you expect your student to use in their course work?

How do you support the digital work you expect your students to complete?

How has your students' digital needs changed over that last year?

Is there any digital technology you used in your teaching and learning that changed the way you and your students worked, communicated, collaborated and presented information?

How would you describe a digitally agile student in your discipline?

What digital support would you like included in a students' learning space?

## Appendix 7 Student survey first years

### Your IT support needs

This short form is anonymous and gather information on what **IT software support questions you would like included in your skills for study and work modules and ask a chatbot**. This research will provide three uses;

1. provide you the opportunity to input your digital requirement into the module
2. provide you with 24/7 digital supports over your BA degree
3. provide me with data for my PhD

Thank you for taking the time to complete this survey. Take care Niamh



\* Required

1

What digital skills or capabilities would you like included in your skills for study and work modules and like your chatbot to answer? \*



**Jisc digital capabilities framework: The six elements (JISC, 2019) Image is licensed under CC BY-NC-SA)**

Enter your answer

2


If you used the chatbot how did you find it? If you did not use it, why not? This information will help if this project will continue. \*

Enter your answer

## Questions on how you regulate your learning. \*

	Strongly Disagree	Disagree	Uncertain or Unsure	Agree	Strongly agree
I find it hard to set goals for myself	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am able to accomplish the goals I set.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I make too many plans so it is hard to focus on one.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can easily get distracted from my plans if I run into difficulty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am open to other ways of doing things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident using new software.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I regularly search for course-related supports	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I change the way I do things when things are not going to plan.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

4

Study skills \* 

	Never	Sometimes	Usually	Always
I schedule defined times and outline goals for my study	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I begin module assignments well in advance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I relate material in one module to material in other modules	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I learn for myself and to understand not just for passing a module	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I ask questions when I need help	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I reflect on what went well and what I need to improve on.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

5

What software do you use to manage your college work, time and planning? For example calendar app, To-Do app, Planner app, scheduling software, OneDrive file management and collaboration etc. \*

Enter your answer

6

**What motivates you to learn? This will help with module and chatbot design. Thank for your input \***

Enter your answer

## Appendix 8 Design and development process documentation

Providing opportunities for others to gain practical outcomes from my research aligns with my teaching mantra, so to this end I have documented my chatbot development, in addition to presenting findings and discussions. From researching feasibility and access to available software as an academic member of staff, I choose the application programming interface (API) of *Microsoft Power Virtual Agents (PVA) for Teams* as the developer environment for my chatbot. (For information the initial development took place in June 2021 and the development environment of PVA is constantly changing and adding new features.) As published in PVA documentation “If you can access *Teams*, and if you can add the *Power Virtual Agents* app, then it is likely you already have the necessary licenses” (Microsoft, 2021, para. 1). I chose this version while limited in some functionality, it was available to all staff in my college, and I did not have to ask our IT services for administrative support or any external support to create or deploy the chatbot. This section provides a detailed walkthrough of my development process to encourage others to develop a chatbot. The initial step is to create a team in *Microsoft Teams* and then create a chatbot in this team. This involves installing the *Power Virtual Agents* app in *Microsoft Teams*. This places the *Power Virtual Agents* app in the left-hand panel of your *Microsoft Teams* interface (see Figure A-1 *Power Virtual Agents* appears on left hand icon menu Figure A-1).

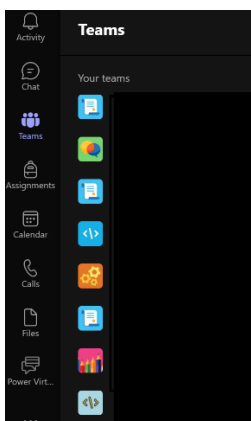


Figure A-1 Power Virtual Agents appears on left hand icon menu

A short video provides an overview of the application (see Figure A-2). Click the Chatbots link to create a New chatbot or open a chatbot you have already designed (see Figure A-3).

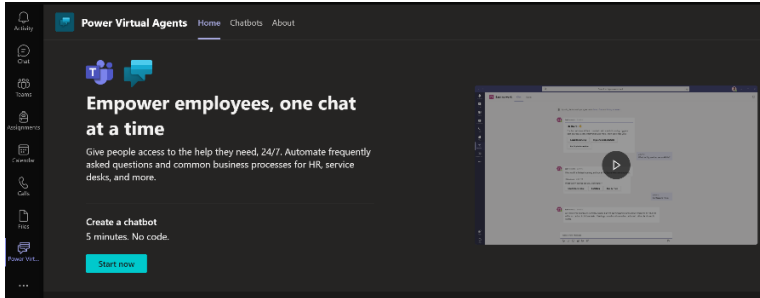


Figure A-2 Power Virtual Agents starting interface.

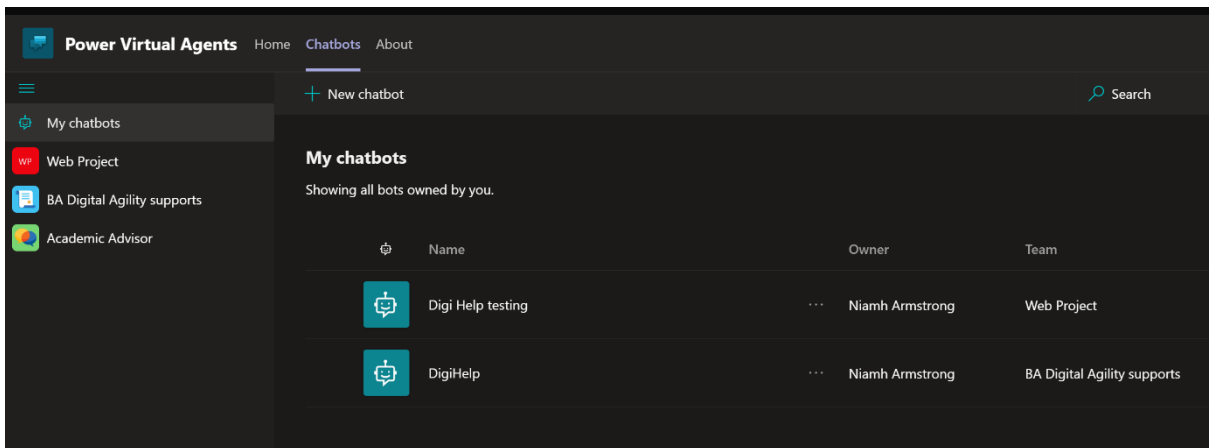


Figure A-3 Chatbots setup

When you click the New chatbot you are presented with a list of your Teams, scroll to view all and select the team you wish to add the chatbot (see Figure A-4).

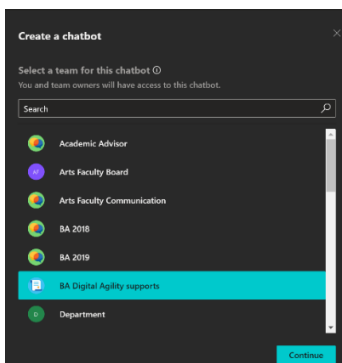


Figure A-4 List of Microsoft Teams

On choosing a class team I got an error that, after research on the PVA community, seems to be a known limitation on the PVA community space. (Note, if you want to post a message on the community it requires admin approval from your organisation). After some experimenting, I discovered that I could not use PVA with a Class team in my institution but with a Professional Learning Community (PLC) team it worked. The process takes a few minutes (see Figure A-5) and once your PVA is available in your team you get an email to confirm (see Figure A-6).

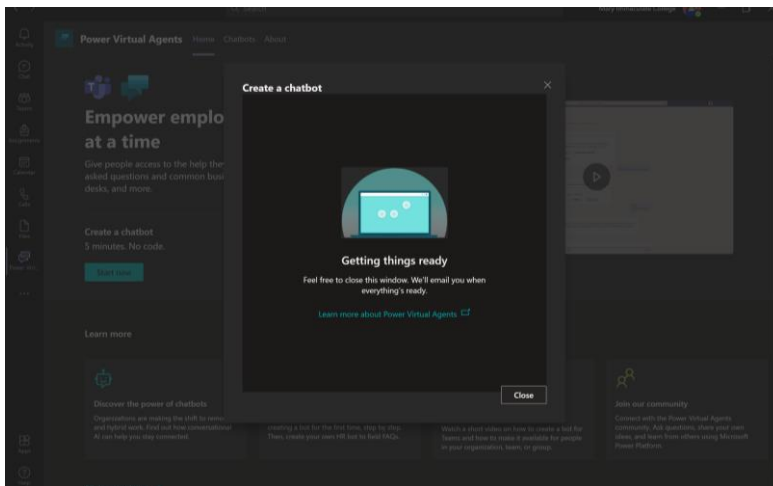


Figure A-5 Initial setup

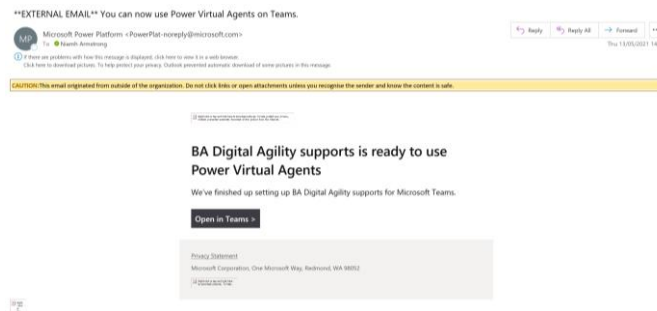


Figure A-6 Email confirmation

Once the Team is ready you can start to set up your chatbot environment, by filling in the fields (see Figure A-7), and then choose Create.

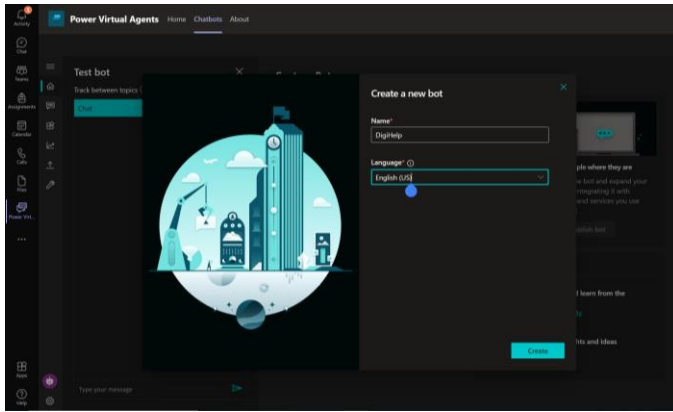


Figure A-7 New bot development environment

This process will take a few minutes (see Figure A-8).

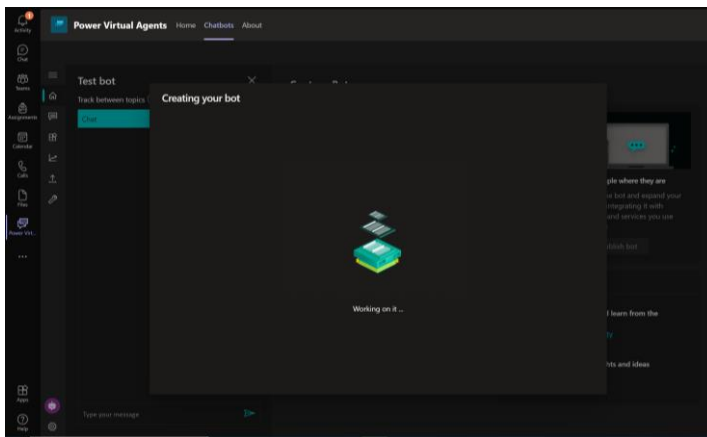


Figure A-8 Waiting icon on setting up the chatbot environment.

When the chatbot environment is ready you get the development interface (see Figure A-9).

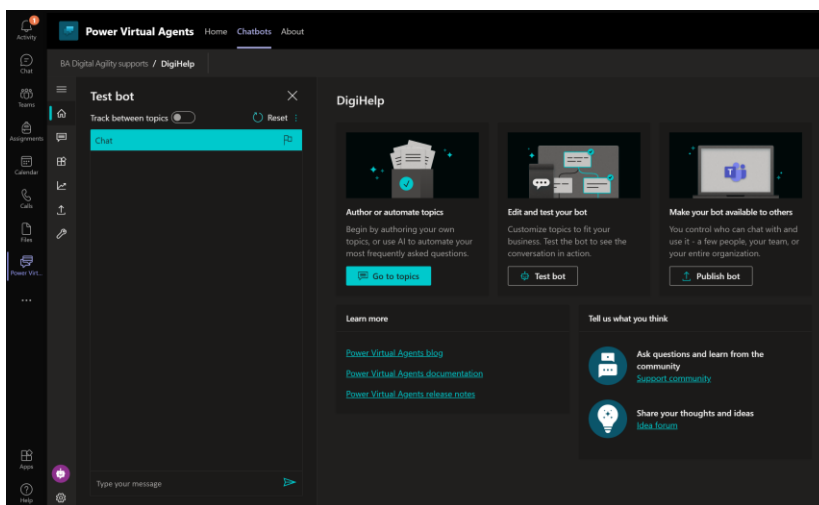
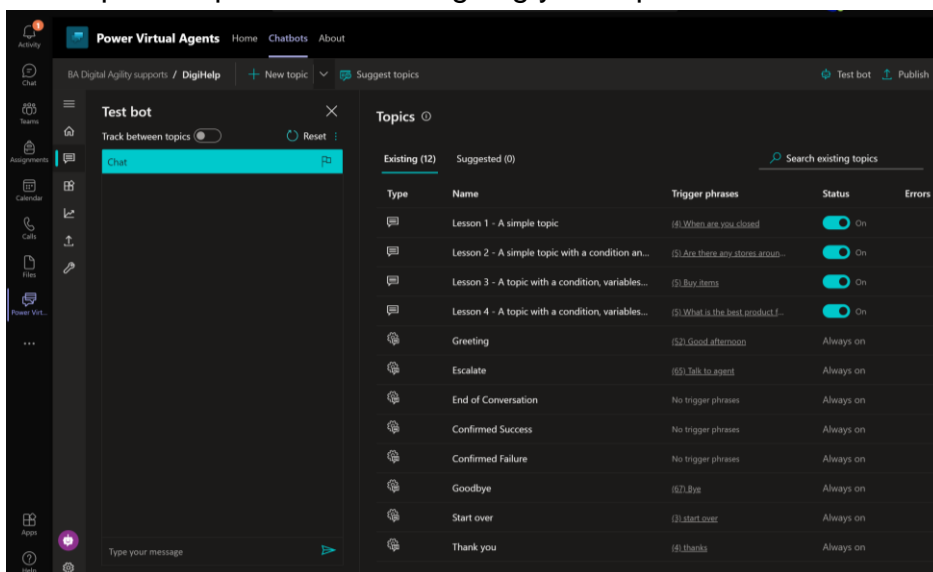


Figure A-9 Development interface.



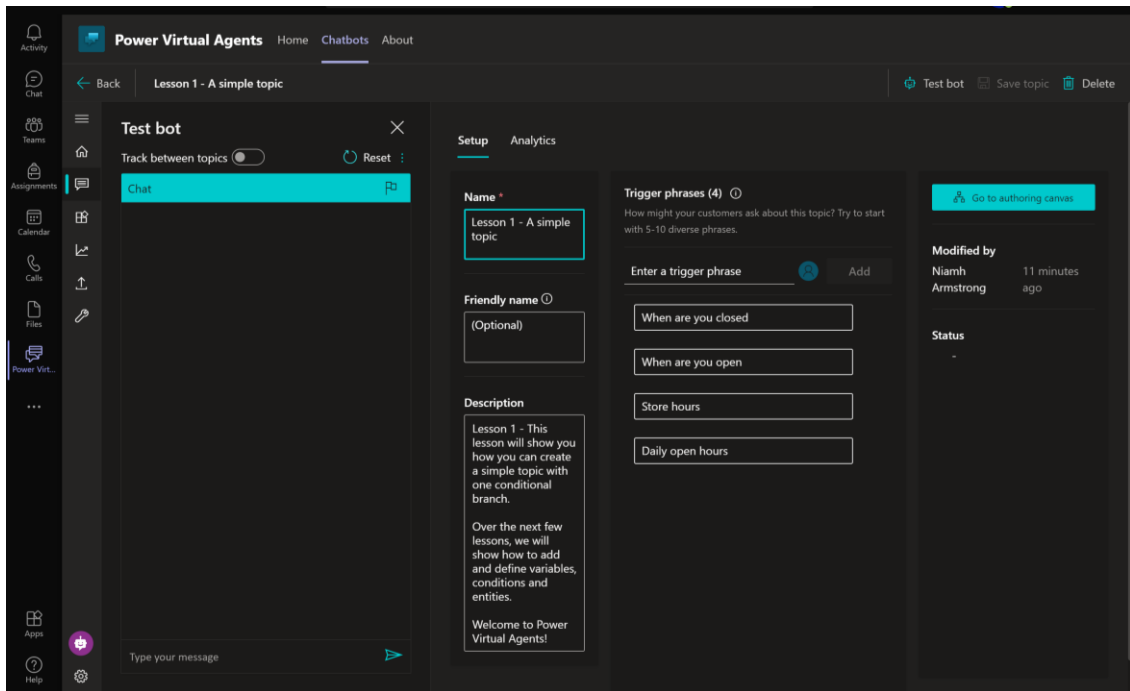
The initial development starts with Go to topics. Topics are the different conversation paths the chatbot can address. The PVA developer space provides a number of prebuilt Topics using examples from a retail shop. The four lessons provide examples of different functionality of the chatbot (see Figure A-10). While the context is not specific to an education setting, these are a useful learning space to test and preview the design environment. I recommend spending time looking at the lessons to get a feel for the chatbot development space before designing your topics.



**Figure A-10** Sample topics

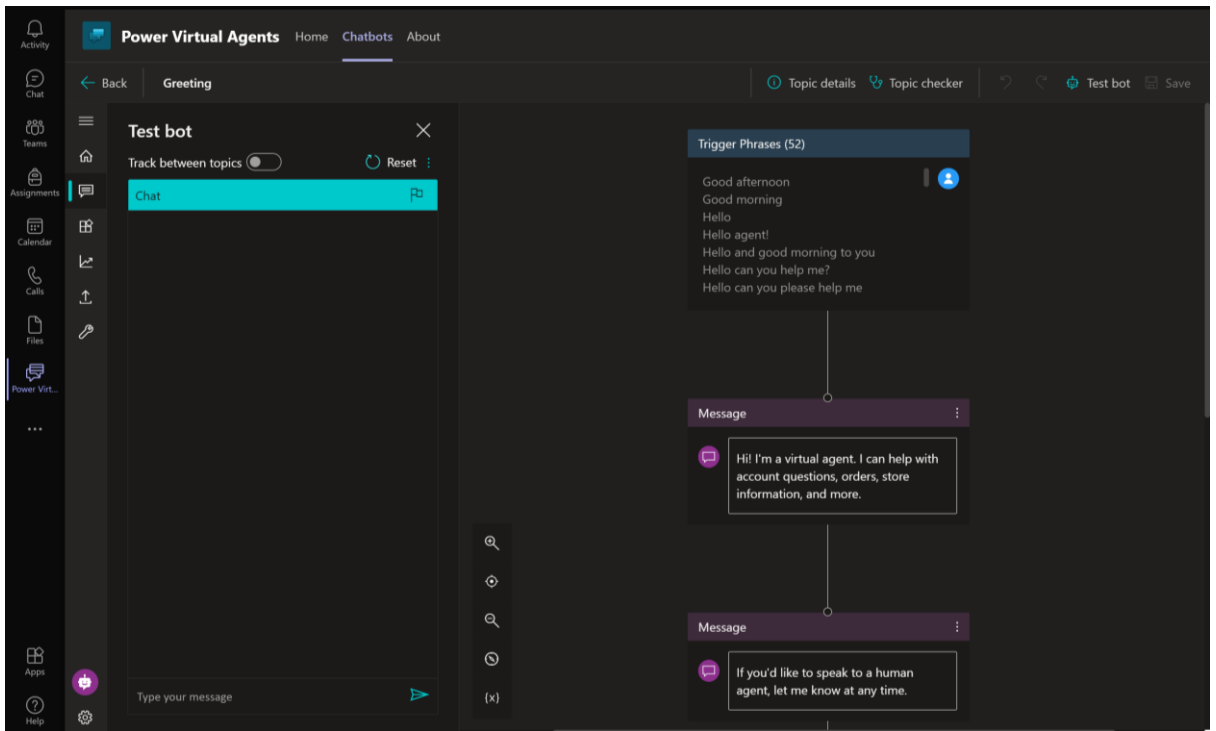
In addition to lessons there are built-in system topics - greeting, goodbye etc. The trigger phrases for these system topics cannot be edited but you can edit the path of the conversation option to add a node to control the conversation path. I recommend creating your own end of conversation, confirmed success and confirmed failure, as the system built-in topic asks for a rating and if this is asked every time it is used, it is off putting. This end of conversation is fine for a system that is used seldom, but if you are using the chatbot as a support space you want to encourage students to continuously check the system for new features.

To view each topic, click the topic and it opens the topic window (see Figure A-11).

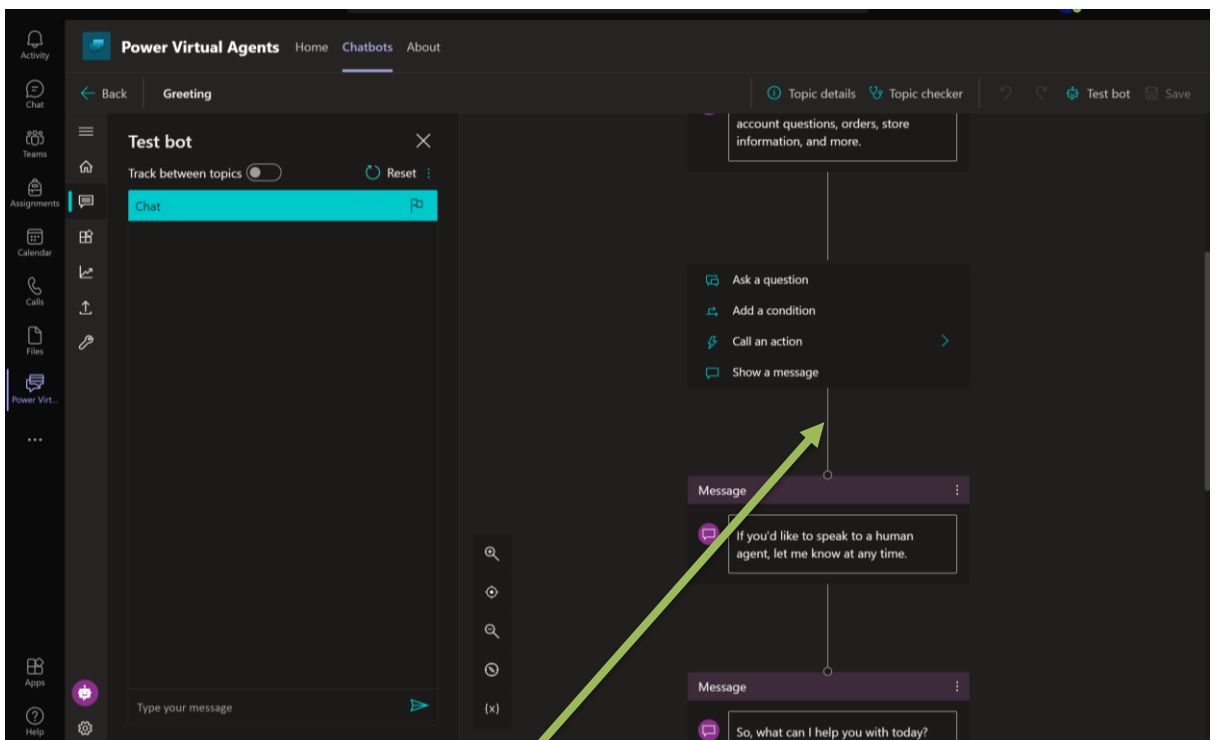


**Figure A-11 Topic view**

Note all topics consist of a Name, Description and Trigger phrases. Name and description do not need an explanation, but Trigger phrases are the text the user is likely to type in, these are keywords or questions your chatbot can respond to. These trigger phrases are the words your chatbot is watching out for. Open the Greeting topic and note there are 52 different ways to get into the greeting topic that activates a response. To view the conversation path linked to these greetings click Go to the authoring canvas. This provides you with an overview of the conversation path that is activated from a greeting. The Trigger Phrases are linked to a message that in turn is linked to another message depending on the developer's path design (see Figure A-12).



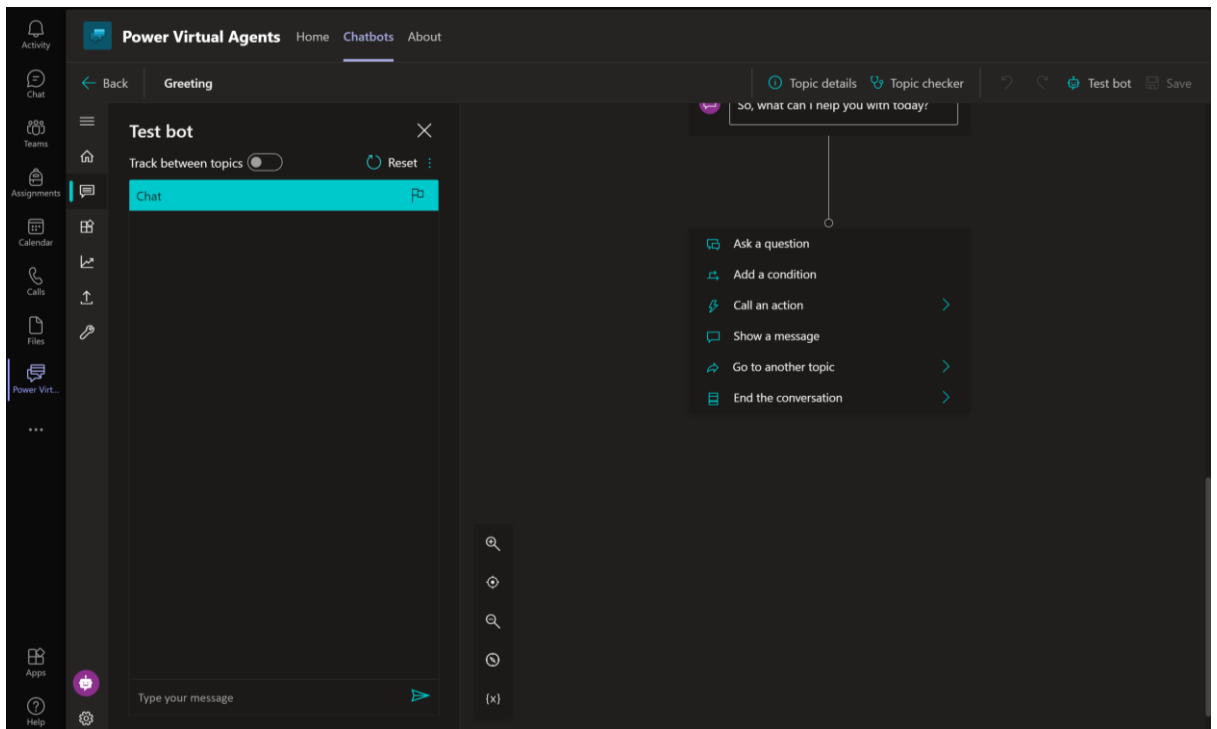
**Figure A-12 Conversation path of a topic interface**



**Figure A-13 Conversation path in interface development space**

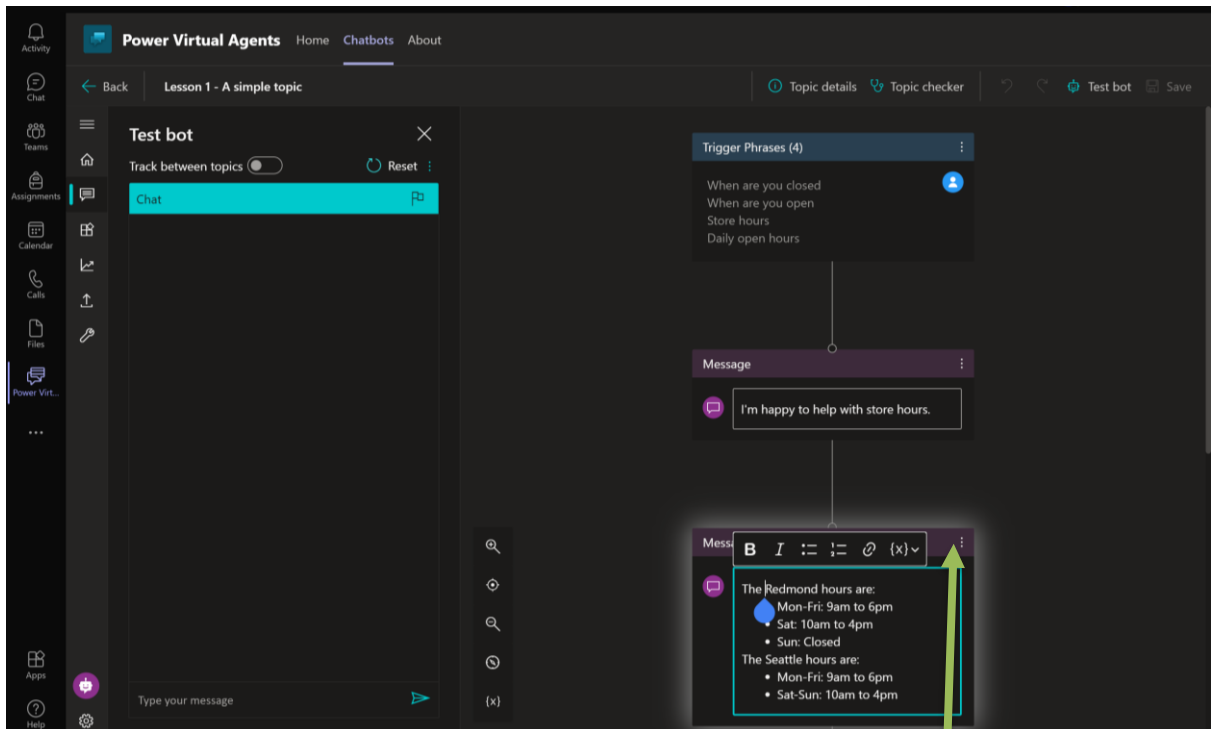
If you click on the connections line you get a menu to view the different options or nodes available to use – Ask a question, Add a condition, Call an action and Show a message (see Figure A-13). At the end of the last message these

options are expanded with the addition of Go to another topic or End the conversation is available (see Figure A-14).



**Figure A-14 Conversation path options expanded at the end of topic.**

This authoring canvas is the development environment, and it is advisable after every edit and node change to test your bot to make sure it is behaving as intended. To edit click inside any message and note the formatting options Bold, Italic, Bullet list, Numbered list, Link or Insert variable.



**Figure A-15** Interface when editing a node

For each node you have the option to delete by selecting the three dots on top right-hand corner (see Figure A-15).

As stated, it is useful to spend time on navigating the four lessons supplied in the developer environment to get an overview of the different ways a topic can be designed.

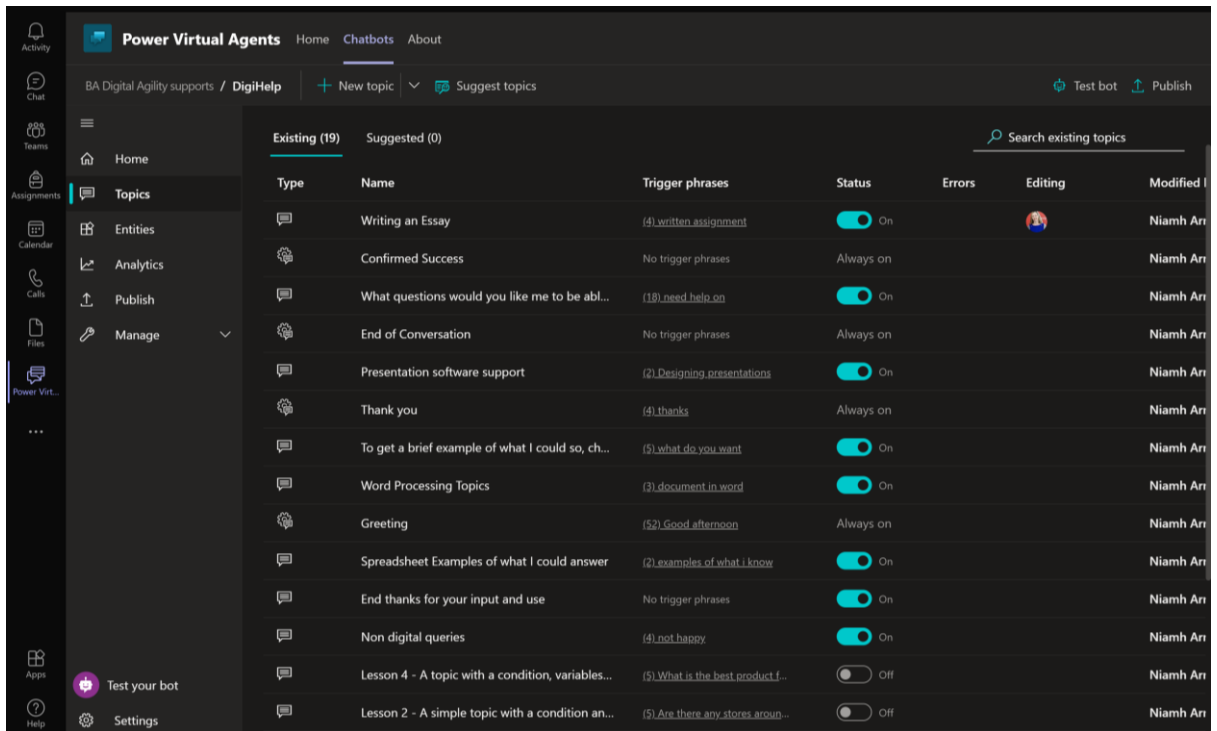


Figure A-16 DigiHelp in development based on student requests.

When designing topics that students' requested care needs to be taken to link the conversation with other topics if needed (see Figure A-16). Detailed planning of the conversation flows provides students with a user interface that students can navigate seamlessly.

Once you have an initial design Publish your bot to make it available to students. On the left-hand panel click Publish (see Figure A-17).

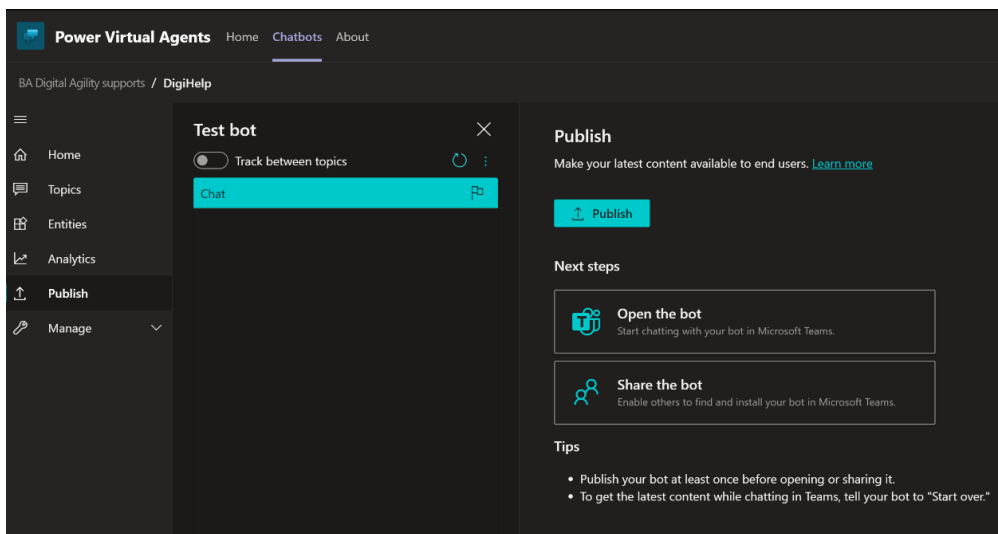
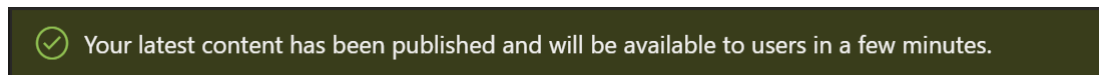
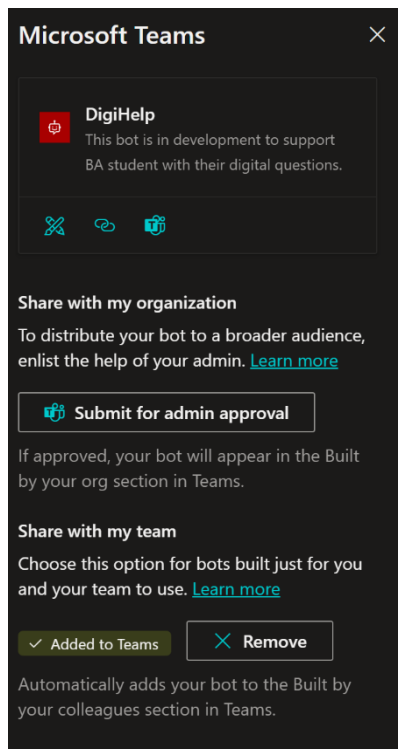


Figure A-17 Publish interface.

This process will take a few seconds but when completed you will get the message below.



To deploy your chatbot so students have access to it, firstly they need to be enrolled on the *Microsoft Team* the chatbot is linked to. Then select Share the bot option as on Figure A-18.



**Figure A-18 Share interface**

I used Share with my team for immediate use and click Add to Teams (see Figure A-19) added to Teams. To get the link for students to use, click the link icon to copy the link for this bot and paste this link into the conversation space of your Team.

Students can then click this link and it opens your chatbot for students to Add to their Teams chat space (see Figure A-19). Once added, the bot is visible in their chat like any other chat conversation.

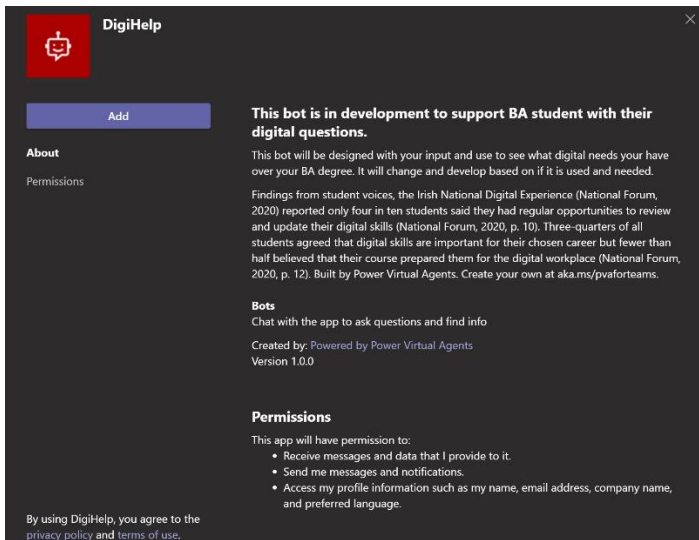
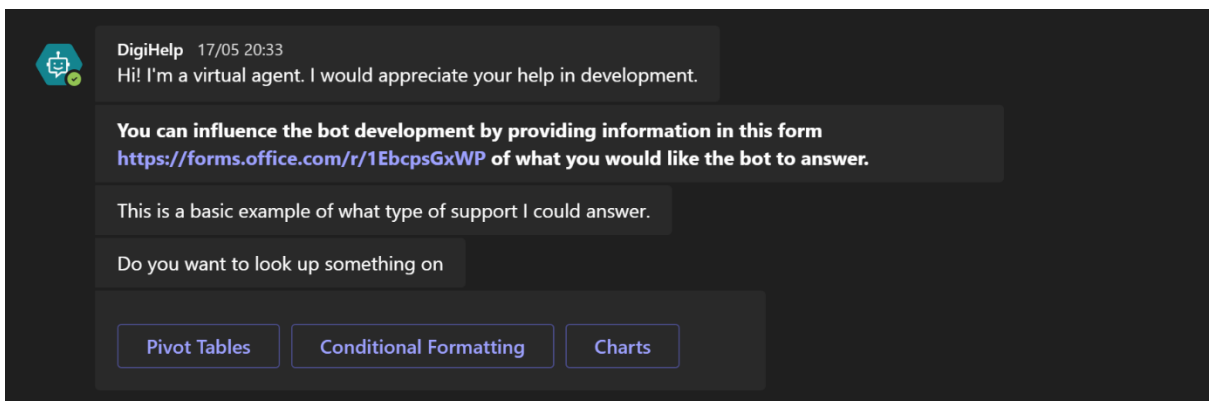
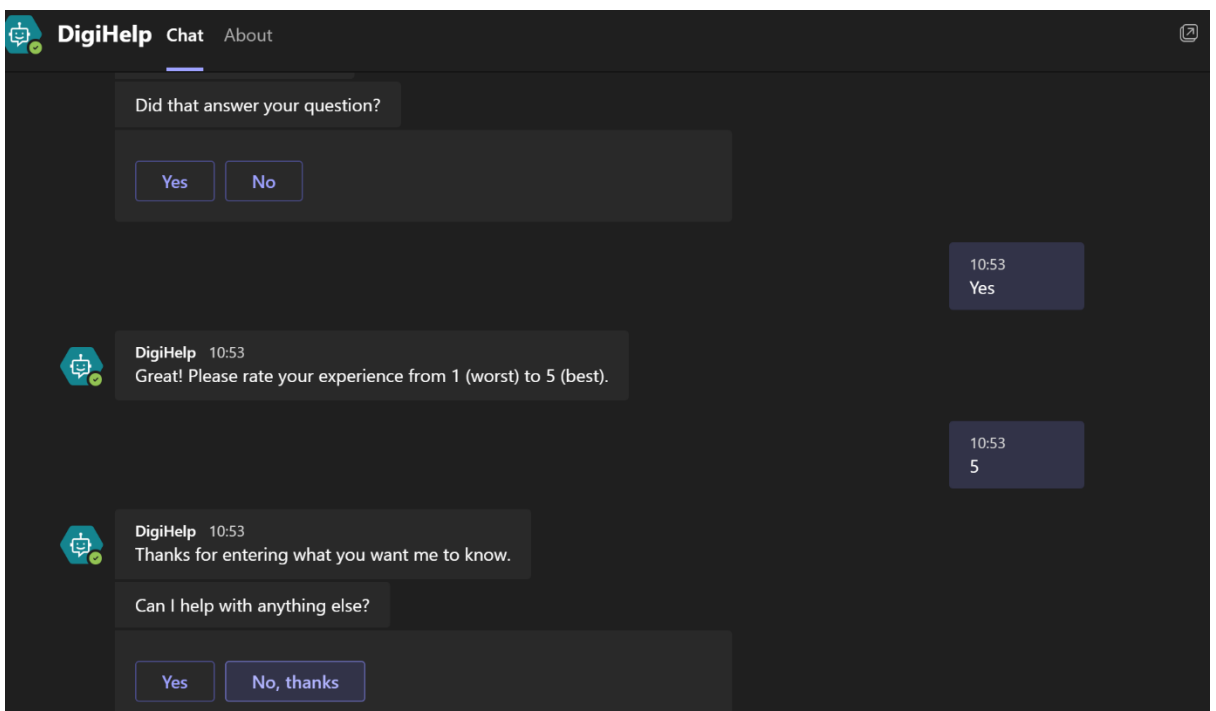
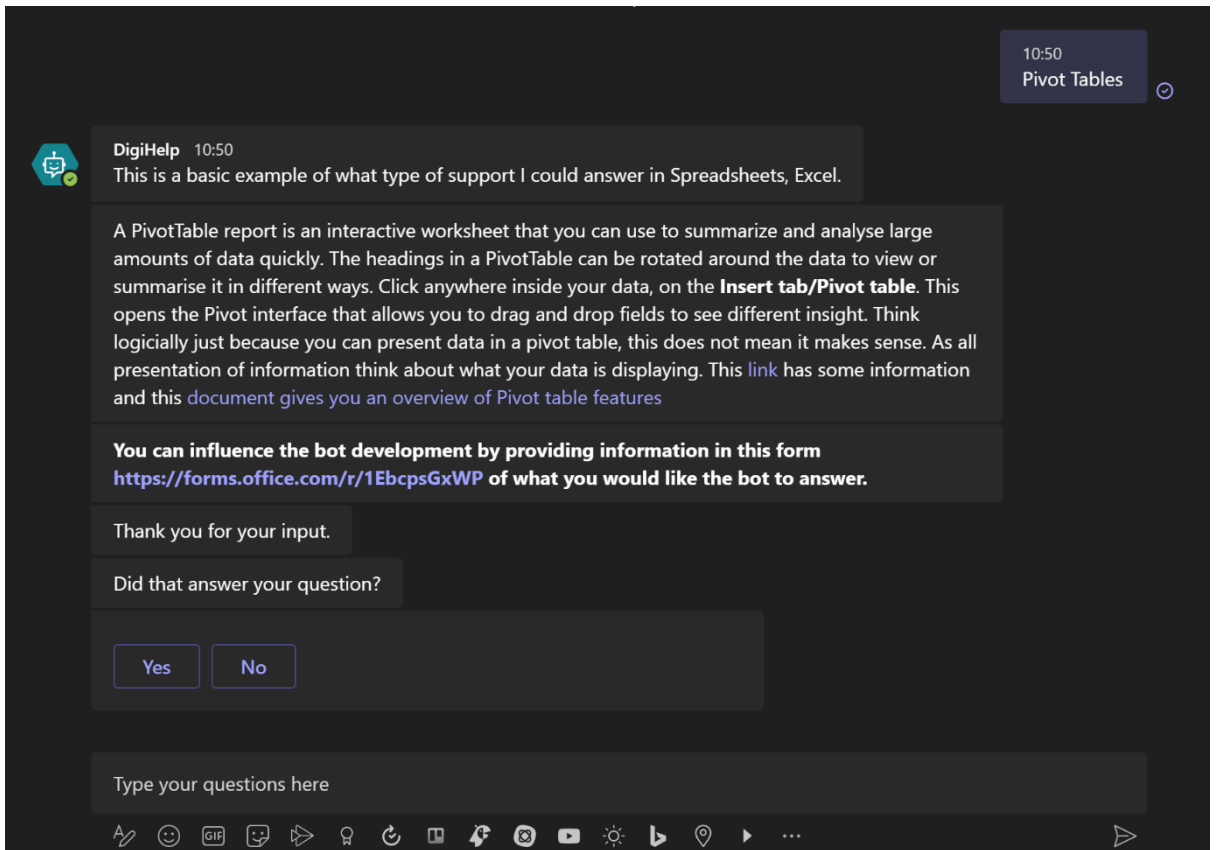


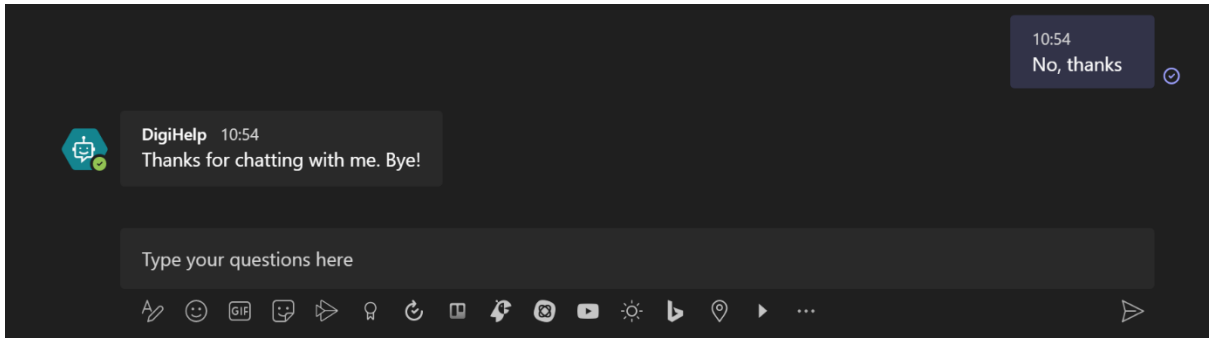
Figure A-19 Add chatbot to chat on Microsoft Teams.

Below are examples of my initial chatbot testing (see Figure A-20).









**Figure A-20 Chatbot interface testing examples**

This documentation of the development journey is included in the hope to empower you to create a similar intervention. All the best.