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# Innovation in Language Learning and Teaching

**Title:** *Scaffolding learning: developing materials to support the learning of science and language by non-native English speaking students.*

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**Abstract:** *In recent years the UK, like many other English first language speaking countries, has encountered a steady and continuous increase in the numbers of non-native English speaking learners entering state primary and secondary schools. A significant proportion of these learners has specific language and subject learning needs, many of which can only be addressed by: (a) specialised teacher training courses and (b) the use of academically appropriate, context- and language-specific materials. At present, such materials are largely non-existent for use in primary school contexts across the country. This article addresses this gap and proposes a set of innovative classroom-based and take-home materials aiming to support the teaching and learning of science at Key Stage 2 of the English National Curriculum. The materials were developed as part of an intervention research project conducted over a period of 24 months (2013-2015) in four state primary schools in Sheffield with a varied density of English non-native speaking learners. The materials were piloted with nearly 400 learners over a period of 10 months; the teachers were trained in using the materials prior to their trial. In this paper core features of the materials will be highlighted and their main functions discussed. Specific emphasis will be put on the following aspects: (a) support for language development, (b) support for subject knowledge development, (c) use of the first language in learning through the medium of a second language, (d) development of learner autonomy, and (f) promoting learning outside the classroom – making use of parental resources. The article will also argue that the proposed materials can be used equally effectively with non-native and native English speaking learners.*

**Introduction**

Since 1997 in England the number of EAL pupils, i.e. pupils who do not speak English as their first language, has doubled, reaching over a million, which accounts for more than a third of the entire state primary and secondary school population in the country (NALDIC, 2015). In the light of this steady increase of the EAL population in state schools, English education authorities have started developing EAL-friendly materials to support mainstream teachers, who are often non-EAL specialists, in educating EAL learners in their classrooms. This practice has recently become rather common at secondary school level. At primary school level, however, EAL-friendly materials are largely yet to be developed.

Educational materials have been developed, to an extent, for use in CLIL (content and language integrated learning) contexts – mainly in secondary schools but in some primary schools (for example, in Spain) (Blair et al, 2014; Zarzuelo et al, 2006; Weeke, 2006; Chamot et al, 2003; Chamot, 2009). These are contexts in which – mainly in Europe, but also further afield – learners learn

subjects in a second language. These materials are similar in purpose to EAL materials. However, many primary school teachers in the UK are either unaware of them, do not have access to them, or find them linguistically or contextually inappropriate for their learners. For example, materials can be too simple or too advanced for a specific group of learners; some topics and facts which the English curriculum requires may be not covered; or the contents might be inappropriate for the English context. To take an example of contextual inappropriateness, Spanish CLIL science materials (Zarzuelo et al, 2006) also contain aspects of Spanish geography (e.g. 'Landscapes of Spain'). In terms of linguistic inappropriateness, CLIL materials developed for use by learners at an 'Intermediate' level of target language proficiency are unlikely to be immediately suitable for 'Beginner' learners in England. There are also many web-based EAL/ESL/CLIL materials (Crick, 2015; Catalonia, 2015; Asturias, 2015; the Basque Country, 2015; HTL Bildung Mit Zukunft, 2015) and EAL/ESL materials supplied by governmental and non-governmental agencies (DfE, 2002; EAL Nexus, 2015, Collaborative Learning, 2015; NALDIC, 2015).

In order to make at least some use of existing EAL/ESL materials the teachers have to, first of all, find and then adapt them for use in their classrooms. Afitska and Clegg (forthcoming) report that this practice tends to be problematic for at least two reasons. Firstly, while the authors argue that 'using a wide range of resources to develop one's own materials for any group of learners is a good thing', they warn that 'the consistency and wholeness of such provision [can be] affected by the teachers' searching and materials' development skills' (ibid). In other words, EAL learners in the schools where the teachers have 'better' materials searching and development skills are more likely to receive a broader 'variety [...] of EAL-materials and [potentially more] knowledge embedded in them' than learners in the schools where such good practices are not common (ibid). Secondly, often 'the teachers [...] do not have enough time to prepare high quality EAL materials for their English non-native speaking learners' as it can routinely take them anything between an hour to several hours to prepare for one lesson (ibid). Yet another common problem associated with the use of teacher-developed EAL materials in the classrooms is that occasionally these materials insufficiently differentiate between the learning needs of the English language learners and those of learners with special educational needs or lower-achieving native-speaking learners in the classroom (see also Driver and Ullmann (2011) on this issue). In the light of these problems, the project presented in this paper takes early steps towards the development of EAL-friendly materials for centralized use in primary classrooms across the UK.

**Theoretical overview**
Language support is a key function of all education aimed at helping learners to learn subjects with limited or developing levels of ability in the medium of instruction (Ball et al, forthcoming). Its purpose is twofold. Firstly it provides learners with the language they need to learn subject concepts; and secondly it

helps them to use their cognitive resources effectively in the learning of both language and subject knowledge. Let us look first at the question of language for learning subjects.

It is important to clarify here that the concepts of 'language support' and 'language acquisition' are related, but different. They overlap, but involve slightly different procedures and aim at slightly different outcomes. This relationship is recognized in EAL/ESL, for example in the distinction between content-based language teaching and sheltered subject teaching in the USA (Echevarriá et al, 2013), where the emphasis in sheltered subject teaching is on 'making content comprehensible', and in content-based language teaching on helping learners develop their academic language proficiency. Helping children acquire language means exposing them to the target language in use, engaging them with it actively and giving them plentiful opportunities to produce it on their own in different contexts and stations. Language support for subject learning, on the other hand, means providing children with the linguistic items immediately needed to support their acquisition of the non-linguistic content of the subject taught as part of the national curriculum. In this way language support is limited to the immediate application of the language in a given context. Language acquisition, however, goes beyond the immediate use of the language for subject learning and provokes learners, through extensive exposure to various linguistic forms, meanings and functions, to 'notice' how language is generally used in wide variety of situations and contexts. By such extensive and multiple exposures to the language, both explicit and implicit, language learners become aware of the gaps between their interlanguage and the target language and work towards closing of these gaps to help them improve their target language proficiency.

Of course, the type of language support described above may not support and facilitate language learning as effectively as explicitly-focused language acquisition exercises and tasks can do. In mainstream content-oriented classrooms (such as science, mathematics, physics) explicit teaching of language is not always possible and is not always needed. In immersion and EAL withdrawal classrooms, however, opportunities for extended exposure to the target language should always be provided.

It is relevant in this respect to note that in their interviews below, the teachers talk about language support and not so much about language acquisition. This could be for two reasons. Firstly, the teachers did not feel that it was their responsibility to teach the target language explicitly to their learners. Secondly, they might have felt that they already had adequate resources and skills to support the learners' language development when using mainstream subject-specific materials. For example, during the study one teacher did reciprocal reading with her class. She went through sentences and paragraphs one by one and dealt with unfamiliar words, explaining their meaning to the learners, as

they appeared in the text. The problem was that there were far too many unfamiliar words and the text was far too long and cognitively demanding for the learners of that age group. In this project, therefore, it was felt that what the teachers needed was further assistance with making the immediate subject content more linguistically and cognitively accessible to the learners by means of providing them with focused language support. A later goal of the project is to focus more on language acquisition by making the general linguistic content (written, recorded or teacher-produced texts) more accessible to the learners through the provision of (a) the right doses of the target language in use and (b) more opportunities to use the target language in free and controlled situations.

The second aim of language support activities in the classroom is to allow learners to use their cognitive abilities efficiently. The cognitive resources of learners who learn subjects in a second language are often overstretched: they need to pay explicit attention not only to the new subject concepts but also to the new language in which these concepts are expressed. Learners working in their first language can often use their language abilities to a degree automatically: they do not always need to divert cognitive resources explicitly to focus on how to use language to process new concepts. Learners working in second language, however, need to do this if they are not yet fluent, and as a consequence learning can be slower and less effective than first language-medium learning. Language support, in providing learners with language resources, enables them to divert attention away from the new language and towards the new concepts. They need therefore to focus only on one thing rather than on two. There are many sources of language support, but the main source is the task, presented either on paper, on the board or electronically. Below I will discuss how language support tasks are constructed and how they interact with the cognitive demands of learning.

Language support tasks provide support for different language skills and at different language levels. Support tasks for receptive skills are by and large similar in type, as are support tasks for productive skills. Tasks for receptive processes, however, tend to focus less on grammar, since it is less salient in the process of comprehension than it is in language production. Productive tasks on the other hand are more demanding grammatically: learners need to direct mental resources to the construction of sentences and often need help in doing so.

A task may be more or less language-supportive. Cummins (2000) uses what is now a well-known visual device (Figure 1), for measuring the degree to which a learning task – in particular one designed to help learners working in a second language acquire subject concepts – makes cognitive demands and offers 'contextual support'. A task may be highly demanding in cognitive terms, i.e. it requires the learner to attend to subject concepts which are both new and complex. Such a task would be placed in quadrant D. Tasks in this quadrant are

also 'context-reduced', i.e. they offer less – or indeed no – support in linguistic, visual and situational terms. They may also give no paralinguistic cues: learners may not be able to negotiate meaning, for example by showing in conversation that they do not understand. Individual tasks and written texts – especially those without visual support – can thus be more cognitively demanding than oral and especially group tasks, in which the learner may be able to talk to a teacher or a peer about meaning. A second language-medium learner working successfully on a task in quadrant D must be fluent enough in the language to be able to meet the language demands the task makes fairly automatically and direct conscious attention to the conceptual matter. The less fluent the learner and the more mental resources s/he needs to direct to unfamiliar language, the more difficult this task will be.
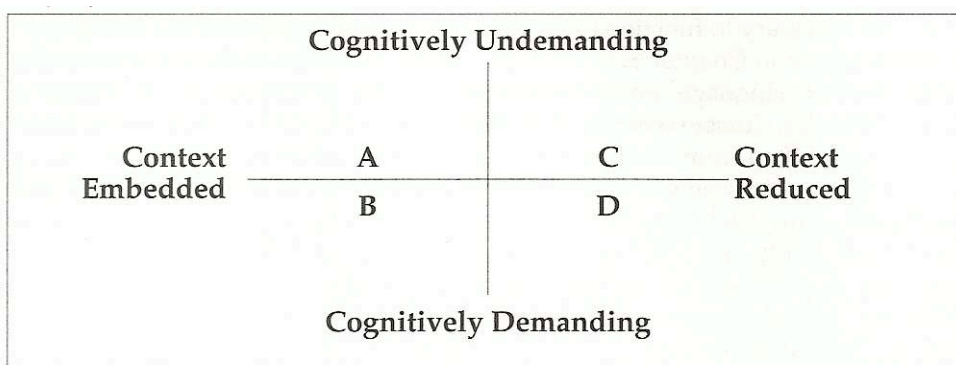


**Figure 1: Cummins (2000): balancing cognitive demands and contextual support**

A task in quadrant C similarly offers little contextual support but learners need it less because the task is cognitively less demanding: it may require the learner to process material which is either familiar or cognitively simple. Learners who are less second language-fluent and who need to think about language use while processing the concept matter, will find that they have more mental resources available to do so.

Tasks in quadrant B, like those in quadrant D, make high cognitive demands. They are, however, more language-supportive in that they offer learners help which enables them to direct to the concept matter the necessary cognitive resources. This help may be linguistic or visual, or it may be interactional in the sense that the learner can talk about the task while doing it. Tasks in quadrant A are both cognitively less demanding and contextually supportive. They are thus easier in all respects. Learners working on these tasks need little language support. Indeed one might say that these tasks have less learning value: they may be insufficiently challenging and teachers may not wish to include too many of them in any given lesson. Similarly, learners who are still developing linguistically will not profit much from doing tasks in quadrant D: they will be both linguistically and cognitively too difficult. By contrast, tasks in quadrant B will challenge learners cognitively in that they present them with subject matter which is new or complex, but at the same time they will offer them linguistic,

visual or interactional support in using their developing second language resources to acquire the new concepts. Quadrant B is therefore the main pedagogical domain in which second language-medium learners and mainstream teachers who support them need to operate. It should be noted in passing that language support should normally aim to avoid making classroom tasks cognitively easier. It should not, in other words, be justifiable to suggest that EAL learners in mainstream classrooms are doing work which is cognitively less demanding than that of their L2-fluent peers. Tasks presented to them should by and large remain in quadrant B. The purpose of EAL support is normally to preserve the cognitive challenge of learning but to make it linguistically more accessible.

Language support tasks, although extensively used in both EAL and CLIL are not widely described or discussed in the literature. Ball et al (forthcoming) and Dale et al (2010) do so for CLIL and a range of language support tasks for EAL in the UK is collected together at the *Collaborative Learning* website (http://www.collaborativelearning.org/). These tasks are not normally found in the pedagogical repertoire of subject teachers. Mainstream subject and primary class teachers will find some fairly easy to make. Others, however, such as some of those constructed within the framework of the project described in this paper, require training and experience and mainstream teachers cannot normally be expected to design them themselves.

**The study**

The data presented in this paper are derived from the EAL science project, a two-year long collaborative research project between the University of Sheffield and Sheffield City Council (2013-2015). Four state primary schools in Sheffield with a varied density of English non-native speaking learners, comprising nearly 400 learners and 15 teachers, took part in the project. The development of a set of innovative classroom-based and take-home materials to support the teaching and learning of science to EAL learners at Key Stage 2 of the English National Curriculum was one of the project's main goals. In order to achieve this goal, the material development ideas derived from existing ESL/EAL/CLIL practical and theoretical resources together with the project's teacher interview data were combined to create a pilot version of materials for the use in target schools over a period of 10 months in the academic year 2014-2015. These ideas were enriched by two collaborative materials development workshops involving the project's lead researcher, a team of EAL specialists and consultants from Sheffield City Council, a group of primary and secondary school teachers working with EAL learners, and a materials development consultant.

**Findings: Teacher interview data**

As part of the project the teachers were invited to share their ideas about the structure and content of future EAL-friendly teaching materials. Table 1 below provides a brief overview of the target teachers' professional characteristics and

their teaching contexts. The data were collected by means of semi-structured interviews and were audio-recorded.

| School code | Density of EAL learners in school | Year group | General teaching experience | Experience in teaching EAL learners | Number of EAL learners in class | EAL learners' English language proficiency |
|---|---|---|---|---|---|---|
| FPS1 | 85-100% | Y3 | < 10 years | < 3 years | 6-15 | Beginner, Intermediate |
|  |  | Y4 | > 1 year | > 1 year | 16-30 | Beginner, Intermediate, Advanced |
|  |  | Y5 | 5-10 years | < 3 years | 16-30 | Advanced |
|  |  | Y6 | 1-5 years | 1-3 years | 16-30 | Intermediate, Advanced |
| TPS2 |  | Y3 | 5-10 years | < 3 years | 16-30 | Intermediate, Advanced |
|  |  | Y4 | 5-10 years | < 3 years | 16-30 | Intermediate |
|  |  | Y5 | 1-5 years | < 3 years | 6-15 | Intermediate |
|  |  | Y6 | < 10 years | < 3 years | 16-30 | Advanced |
| PPS3 | 35-80% | Y3 | 1-5 years | < 3 years | 16-30 | Intermediate, Advanced |
|  |  | Y4 | 5-10 years | 1-3 years | 16-30 | Intermediate, Advanced |
|  |  | Y5 | < 10 years | < 3 years | 16-30 | Intermediate |
|  |  | Y6 | 1-5 years | 1-3 years | 6-15 | Advanced |
| LPS4 |  | Y4 | < 10 years | < 3 years | 1-5 | Intermediate |
|  |  | Y5 | < 10 years | < 3 years | 6-15 | Advanced |
|  |  | Y6 | < 10 years | < 3 years | 6-15 | Advanced |

**Table 1: Descriptive teacher data by school**

The teacher interview data reveal several components that the teachers felt were important for inclusion in EAL-friendly materials.

It should be noted that when talking about language use in their science lessons, the teachers are not suggesting that language activities are in any way separate from science tasks, but see them as an accompaniment to teacher demonstration and practical learner activities.

Firstly, the teachers commented on the importance of clear *presentation of key scientific and technical vocabulary* to the learners. Here the teachers meant presentation as 'naming' or 'stating' – a particularly useful technique for beginner EAL learners - rather than presentation as 'description' or 'explicit explanation'. Two methods were mentioned here: the use of vocabulary sheets and the use of picture cards where the concept was firstly presented visually and then in print:

> T: Maybe something with key words they come across that are different, not necessarily everyday words. Trying to stay away from the everyday words […] Scientific vocabulary, looking at different words, and maybe some pictures to go with it. (TI-Y4-H-FPS-21.10.2013)

> T: Vocab sheets is always a nice one, writing frames, like key word things (TI-Y3-M-PPS-18.11.2013)

T: Giving them lots of names of materials, names of properties – hard, strong, smooth, transparent, translucent, opaque – giving them all these words prior to the lesson starting, talking about it (TI-Y3-H-TPS-18.10.2013)

T: for me the most helpful thing would be if you took this unit for instance for year 4 and somebody had made a vocab sheet or a picture and answer you know to go with that at the beginning or work you know TA could spend time with those specific children in the classroom (TI-Y4-H-TPS-18.10.2013)

The purpose of drawing learners' attention explicitly to core scientific terms was seen as ensuring that learners: (a) could differentiate more or less effectively between these terms during the opening, or presentation, phase of the lesson (use of picture cards), and (b) could use them more or less independently during the more practical stages of the lesson, such as completion of individual written work  (use of vocabulary sheets for spelling) or as a part of group work activities (use of picture cards to support and facilitate scientific talk).

The next most useful component for inclusion into EAL materials mentioned by the teachers, and probably most appropriate for EAL learners with at least a lower-intermediate level of English language proficiency, was the *use of a glossary*, whereby core scientific terms were not merely named or visually presented but were also explicitly explained and defined.

T: Most likely, definitions and also a glossary at the back. […] Like a glossary in the back, to go with the key words that go in there, or maybe different, like the water cycle, or life cycle, like diagrams in there, different things (TI-Y4-H-FPS-21.10.2013)

T: it will be good just to have like a sheet that has all key words, definitions, pictures (TI-Y5-H-TPS-18.10.2013)

During the interviews some teachers have also emphasized the importance of (a) *explaining and clarifying* and (b) *exploiting less scientific*, more everyday, *words in order to exemplify or define 'more' scientific concepts* and ideas.

T: The equipment and the materials that you're going to be using that day, with the pictures or the actual thing, with something stuck on, or a word stuck on it… I mean if it floated, you know, such and such - floats, such and such - sank, things like that (TI-Y3-H-FPS-21.10.2013)

T: if you have key words with a picture to say these things are rough, these things are rigid, so they have an idea, they can link words with pictures (TI-Y3-H-TPS-18.10.2013)

In addition to using glossaries and picture cards (with words) in order to support the EAL learners' receptive skills, i.e. the skills needed to comprehend the lesson's scientific content, the teachers also talked about the importance of

supporting these learners' productive skills, i.e. the skills needed to help these learners effectively talk and write about the acquired content of the lesson. The suggestion for the materials was thus the *inclusion of examples of well-formulated scientific statements and sentence starters* to help learners express and record their ideas using subject-specific (i.e. scientific) discourse.

> T: [They need] more support with how to record it (experiments), how to interpret the results in English (TI-Y5-H-FPS-21.10.2013)

> T: […] some sort of sentence starters as to what they're seeing (TI-Y3-H-FPS-21.10.2013)

> T: I would quite like […] a structure of what a good prediction looks like, a good investigation… because [they] can carry them out, it's the recording of it, like scientifically, what should it look like, what steps that the kids should go through, say you should have like a prediction, a conclusion, a methods and stuff… but how would that look for Year 3, that kind of what I would like, these kind of things (TI-Y3-M-PPS-18.11.2013)

Finally, the teachers' views on the appropriateness of the use of learners' first language in EAL-friendly materials were elicited. The teachers' standpoints on this topic were threefold. Some teachers believed that learners would benefit from *dual-language use*, i.e. the use of English language and the learners' first language, in the materials. Such dual-language use, from the teachers' point of view, would allow learners better to comprehend scientific content expressed via the medium of English language by making links to appropriate parts of contextually identical statements expressed in their first language (assuming that the learners are literate enough in their first language).

> T: I think it'd be beneficial to have both languages, because obviously they can read it in their own language, but they can also see what it is in English, which I think would be very beneficial. Because obviously when as they get older, they are not going to have everything available in their own language… on the first attempt it would be beneficial maybe to have it in dual language, so they can see it in their language, see it in English, and say every time they see this, they know it means this. (TI-Y4-H-FPS-21.10.2013)

> T: Sometimes giving it to them [children] in their own language and English does make it a little bit more easier because if a child let's say is completely new to English and you said 'where is the head' they do not have a clue but if it was a person who spoke in Slovak for example and he said in Slovak 'where is the head' and if you pointed to it then and say in English 'head' so you got that link you know, that would make life a little bit more easier… but it depends, it will depend on what it is that you are teaching (TI-Y3-H-TPS-18.10.2013)

> T: I think it would work generally especially for the Roma children and Slovakian children who are finding English the hardest because they are sort of

new arrivals, I think it would help them perhaps understand, it would probably help them understand it [concepts] better (TI-Y6-H-FPS-21.10.2013)

A second group of teachers, however, believed that learners, particularly those (a) in the earlier years of schooling, (b) with no- or limited- prior experience of education or (c) with limited exposure to the first language at home, particularly beyond its everyday usage (also see Afitska, 2015: 142-143), would not be able to make any use of their first language, particularly in its written form, as they simply were not literate enough in it.

> T: I don't think it would be for my age group, because many of these children have never been to school in their own countries before, so they won't be able to read or write in their first language. For the more able, for the higher schooling it might more helpful (TI-Y3-H-FPS-21.10.2013)

> T: Sometimes giving them something in their home language makes it easier if the children know what that concept is or what language means in their home language … because a lot of the children do not speak a lot of those languages with the elders or their parents at home, so they only really know English (TI-Y3-H-TPS-18.10.2013)

Finally, some teachers believed that the use of the first language in the classroom would not make much difference to the learners' learning if their English language proficiency was higher than 'beginners' or 'new arrivals'. They commented:

> T: For the majority of pupils (whose English language proficiency is either intermediate or advanced) I do not think it would hurt, I think they would like it […] but they would not really need it (TI-Y6-H-FPS-21.10.2013)

> T: I think it is alright if they are completely brand new but that is not appropriate later - they do not need that (TI-Y5-H-TPS-18.10.2013)

The structural organization of the booklets was also informed by the teachers' preferences. All teachers who had an opportunity to comment on this aspect preferred being provided with EAL-specific stand-alone activities as opposed to whole lesson plans with built-in EAL support. The teachers' reasoning and justifications for such preference are provided below:

> T: personally I would prefer just activities because I teach in a way that is like very much 'me'; so I feel like - as long as I have the activities and resources then I could do it how I want it, rather than have a structured lesson (TI-Y3-M-PPS-18.11.2013)

> T: I think the set of activities, as they are more easily adaptable to the class that you've got and it is nice to sometimes have ideas that you would not have thought of yourself (TI-Y4-M-PPS-18.11.2013)

T: Personally I would prefer set of activities for a specific topic, because if somebody else is going to give me a lesson I am not necessarily going to follow up that, I need to know what the objective is and I would need some ideas of the activities that would help me to meet that objective [...] I probably would not follow somebody else's lesson plan (TI-Y5-M-PPS-18.11.2013)

T: Definitely the activities, cos it is always harder to find an idea for an activity; if you got activities [then] you can use [them] as ideas... I think with planning... I personally prefer to plan myself cos I know what's in my mind, I do not generally feel that I can follow anyone else's plan cos it's not what I thought of, not [what] was in my mind, so it is harder to teach; whereas if it was activities I'll be able to base my lessons on the activities, but plan myself and organize it myself (TI-Y6-M-PPS-18.11.2013)

**Implications: Materials development**

The repertoire of language support tasks, which is used in second language-medium education, (for example, in CLIL or EAL) includes tasks which give a very high level of support and those which give less. Substitution tables, for example, support speaking and writing skills by providing support at the levels of lexis, grammar and discourse. In other words, they require the learner to make very few language choices at all and direct mental resources almost entirely towards new conceptual content. Sentence starters give lexical and grammatical support. Writing/speaking frames give support at the discourse and lexical levels but not grammatically. A word list provides only lexical support, leaving the learners to construct both sentence and text. Similarly, receptive tasks vary in the degree of support they give and at the level of language at which it is given. Gap-filling tasks, for instance, focus attention on vocabulary and cohesion. Diagram-labeling focuses on vocabulary. Chart-filling tasks draw attention to discourse structure. Some of these techniques have been adopted for the materials developed in this project.

Two goals, in line with the Cummins (2000) framework, were set up as major targets for these materials: namely, the provision of *support for target language development* and the provision of *support for subject knowledge development*. In order to achieve the first goal the learners were provided with sentence starters to help them talk about their ideas in subject appropriate scientific ways. Each group of sentence starters was ordered by the degree of linguistic difficulty with easier structures being presented first and more difficult structures last (Figure 2). This structural organization gave learners freedom either to use familiar linguistic structures or to experiment with linguistically more advanced structures in a secure environment. The recurring nature of such exercises and the opportunity to record ideas in writing gave learners space to eventually develop their own bank of linguistic resources that could be used to help them express their scientific ideas in future lessons. To support the learners' general ability to construct sentences in the target language in grammatically correct

ways, modelled examples of fully formed sentences were provided in the 'comprehension-check' sections of their booklets (Figure 4).



**Figure 2: Support for target language development**

Support for subject knowledge development was provided by means of glossaries of key terms prior to each topic being introduced by the teacher. Language used in the definitions was simple to ensure as much comprehension as possible by the learners with lower levels of English language proficiency (Figure 3). Additionally, for each topic, less linguistically demanding means of knowledge access, such as visual prompts, were introduced to support comprehension of ideas and concepts. Where it was impossible to present an idea using a labeled picture or diagram, simple sentences and phrases were used to express the scientific facts. To support the learners' understanding of experimental procedures and to help them decode meanings behind the technical names of experimental stages (such as: prediction, method, results, and conclusion), sets of leading questions using simple English language were introduced (Figure 2).

Even though the teachers had mixed views on the usefulness of use of learners' first language for learning science in primary classrooms, it was decided to give learners this opportunity. It was believed that the learners should be allowed to use whatever resources are available to them to support their learning even where teachers did not feel competent, or competent enough, to support them. The view was taken that learners can't demonstrate (or record) their knowledge (or understanding) in English they should not be denied opportunities for using their first language. The proposed materials allowed learners to record their

understanding and developing scientific ideas using their first language in two ways. Firstly, where the learners had sufficient literacy skills in their first language – as measured subjectively by the learners themselves – they were invited to write their understanding of the teacher's explanations, as well as other ideas related to the topic from the lesson's content, in the orange boxes in their booklets (Figure 3).
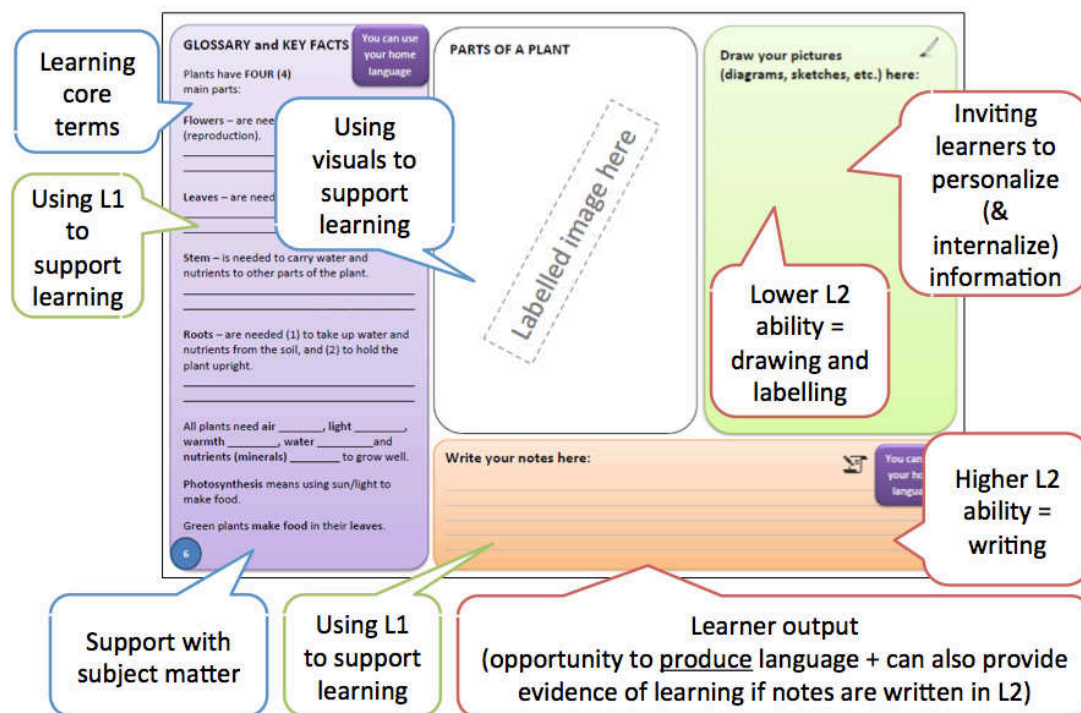


**Figure 3: Support for subject knowledge development and use of first language to enhance learning**

Where the learners did not have sufficient literacy skills in their first language to write in sentences or phrases, they were invited to draw or sketch, and probably label, their ideas in the green boxes in their booklets (Figure 3). The learners were also allowed to mix two languages – English and their first language - in order to record their understanding so long as they felt happy and comfortable in doing so. It must be reinforced here that the main purpose of these booklets is not to assess the learners' scientific knowledge (though some assessment, particularly assessment for formative purposes, is possible, see Figure 4). The main purpose of these materials is to support the learners' comprehension of science as subject matter using whatever resources, linguistic or non-linguistic, are available to them. Grammatical errors, errors in spelling, use of the first language, or the mixing of two languages should not raise (major) concerns at this stage.

As was just mentioned, the materials also allowed some space for formative assessment procedures. Firstly, the teachers could check the accuracy of the learners' developing scientific knowledge by looking at their writing and drawings in the orange and green boxes, subject to these being done at least

partly in English (Figure 3). Secondly, the teachers could assess the degree of their learners' understanding of scientific concepts by looking at their answers to the sets of simple comprehension-check questions that accompanied each topic in the booklet (Figure 4).
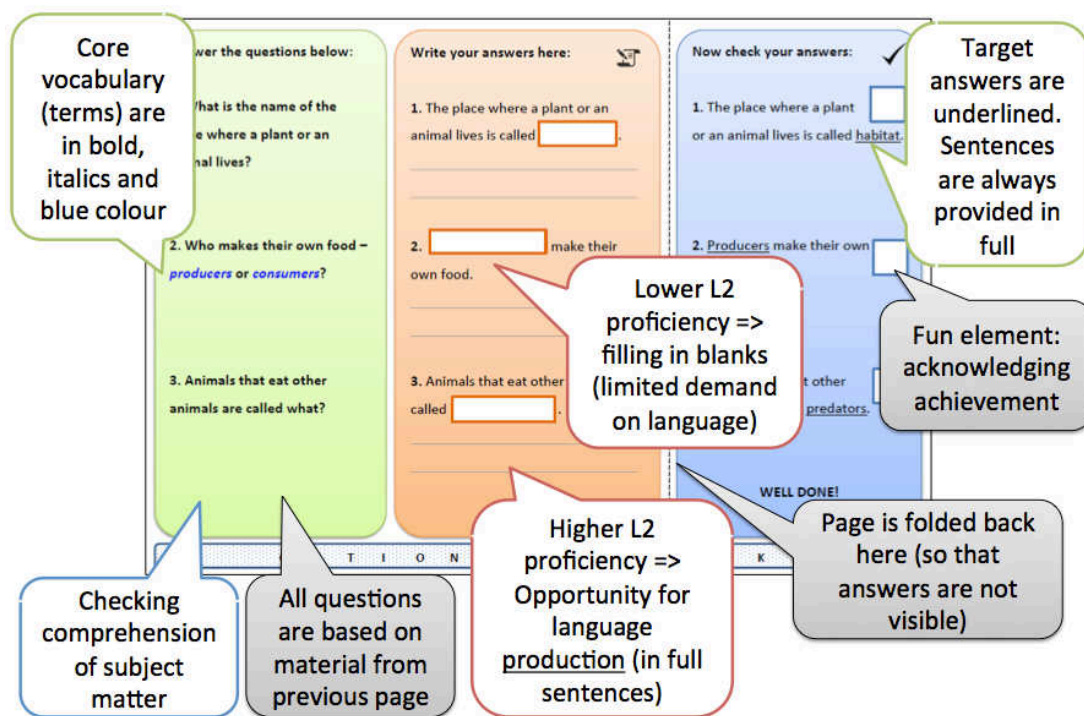


**Figure 4: Informal tracking of learners' progress: opportunities for formative assessment**

All questions in the 'comprehension-check' pages were written using simple language, the same language as was used to introduce the concepts at the beginning of the lesson. Core terms and concepts were highlighted in blue to refer learners back to the glossary of key terms, if needed. The learners with lower levels of English language proficiency were invited to fill in the blanks with core terms or facts in the sentences already constructed for them. The learners with higher levels of English language proficiency were given an opportunity to write their answers freely in the blank spaces provided. Because these materials are learning materials rather than formal test papers, correct answers to the questions were made immediately available to the learners (though initially they were folded behind the page). Thus, if the learners felt that they had difficulties with a particular concept or idea they could immediately find the correct answer to their question in the blue box on the same page (once unfolded). What matters here is not the number of correct responses per page; what matters is the degree of exposure to the subject matter and the extent and explicitness of the learning opportunities embedded into these 'comprehension-check', but still learning-driven, pages. Arguably, even when learners simply copy the answers from the answer sheet (particularly beginner English language speakers) or find them in the 'learning page' of the booklet, they are still being engaged with the subject matter better than they would be without having been

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provided with such opportunities. For example, copying a scientific term letter by letter from a labeled diagram may help learners: (a) to remember the spelling of that word, (b) to link the 'English' name of the word to that in their first language, and (c) to re-construct the understanding of English concept by drawing on existing knowledge about this concept from their first language.

The materials also provided learners with opportunities to develop their autonomous learning skills. Learners can bring considerable knowledge and expertise from their general knowledge about the world into the classroom. It is a pity when these resources do not find application in the classroom. For non-native English speaking learners these resources are crucial - they help ensure that learners do not get lost in the amount of highly technical scientific vocabulary and content that is being delivered to them by means of a (largely) unfamiliar medium of instruction. Encouraging learners to make use of their existing knowledge as well as training them in making the best use of this knowledge independently both inside and outside the classroom, can improve their chances of successful acquisition of any subject-matter, not just science (Figure 5).
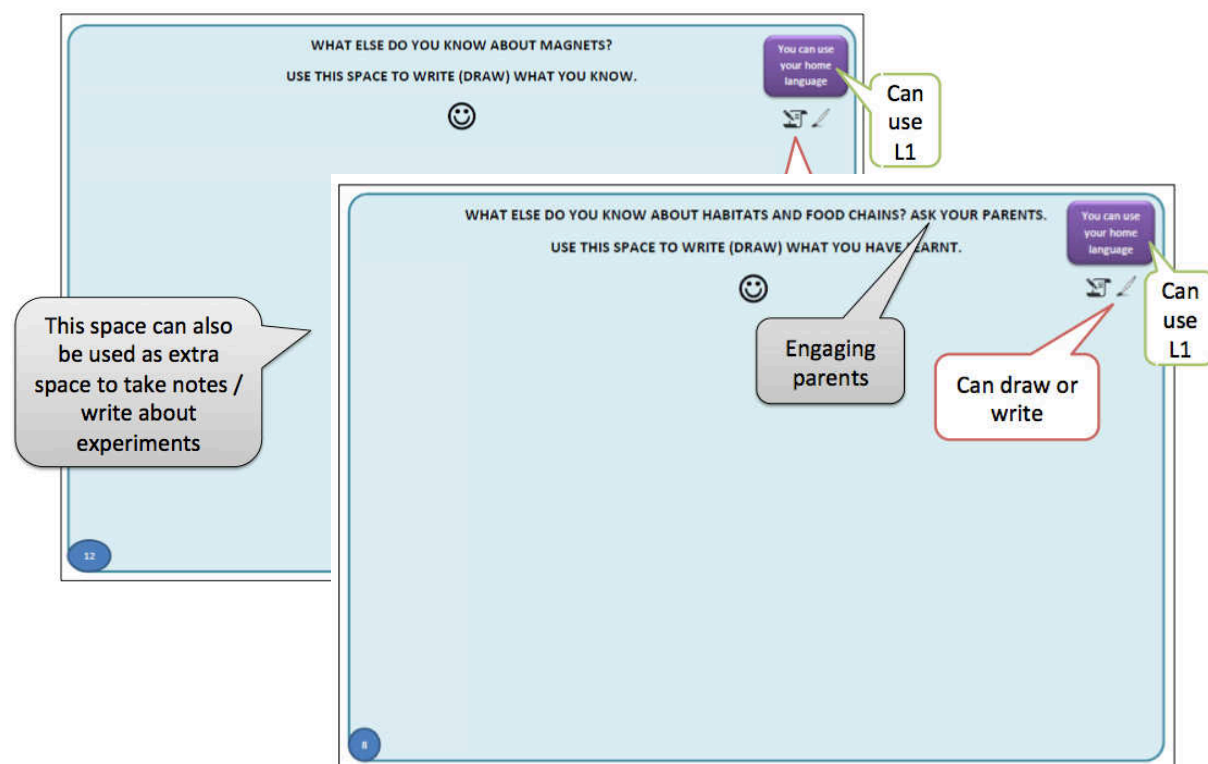


**Figure 5: Development of learner autonomy inside and outside the classroom**

Finally, the booklets ensured that the use of parental resources was made to support non-native English speaking learners' learning outside the classroom. Parents were invited to support their children's learning of science at home by helping them complete their homework tasks based on the knowledge obtained at school (Figure 6) and encouraged to share their knowledge and experience of scientific facts, either in English or in their first language, drawing on routine

daily life examples, in this way making these facts even more accessible and comprehensible to their children (Figure 5).
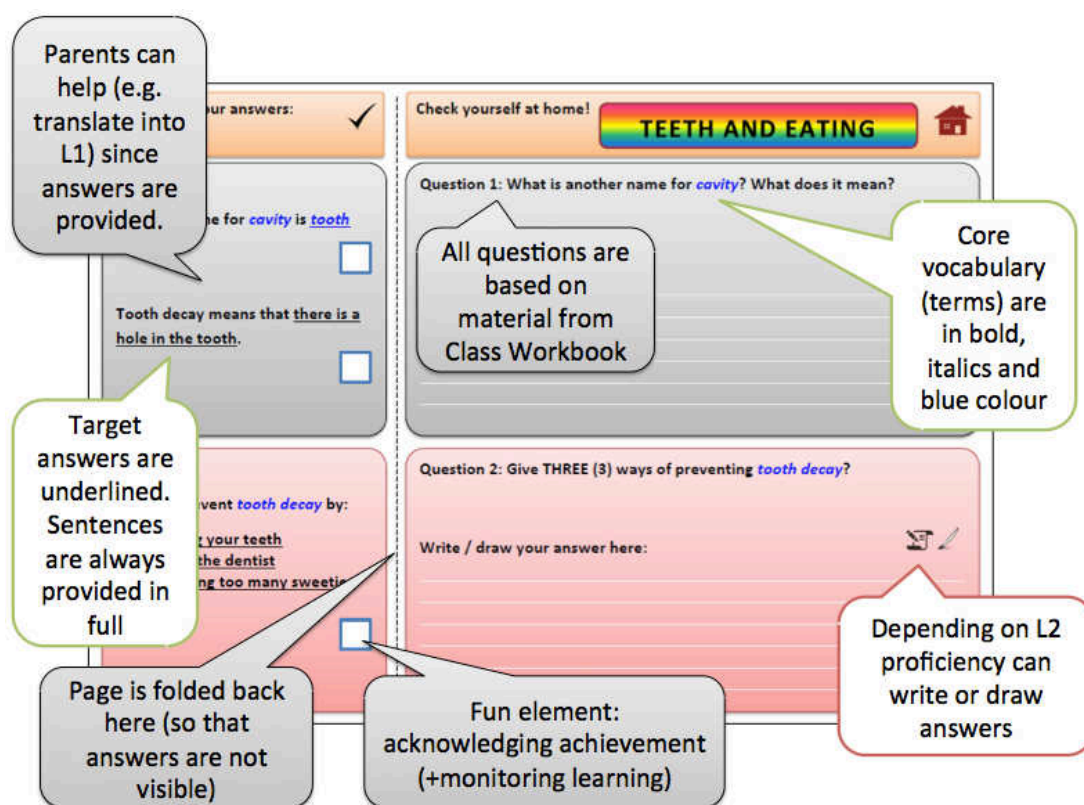


**Figure 6: Use of parental resources to support learning**

## Concluding remarks

Even though the materials presented in this paper were primarily developed to support the language and subject content learning needs of learners with EAL, it is argued that they can be just as effectively used with English native speaking children in mainstream classrooms, and even more so with the children who may have additional learning needs. A good proportion of scientific terms and concepts taught as part of primary national curriculum is new to children regardless of their linguistic or cultural background. As one of the teachers commented:

> In some cases it's no different for a child who has got English as their first language because they have not come across those words either […] in a lot of cases … if they do not know what 'gravity' means it does not matter whether you are EAL or [a native speaker] (TI-Y5-H-FPS-21.10.2013)

Thus it becomes important to ensure that all children in the class understand well the content taught to them in science lessons. Good pedagogical practices both teacher-driven and materials-driven can help in achieving this goal. The materials presented in this paper adhere to the principles of systematicity and consistency: in the presentation of content, in the informal assessment of scientific knowledge, in opportunities for controlled out of school, parent-

supported learning practices and in the recording of learners ideas and knowledge (Figures 7 and 8).
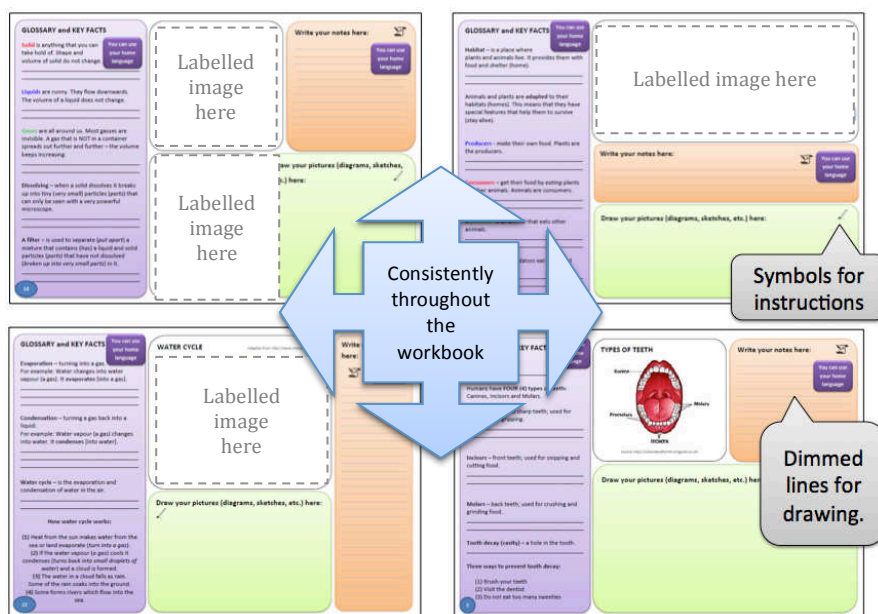


**Figure 7: Systematic and consistent presentation of scientific enquiry in booklets**

The materials also observe good assessment practices. Informal knowledge-checking exercises, presented plentifully in the booklets, elicit learners' knowledge in many different ways (Figure 8) and often reduce linguistic demands, allowing learners to demonstrate their knowledge and understanding in the ways most accessible and most appropriate to them.
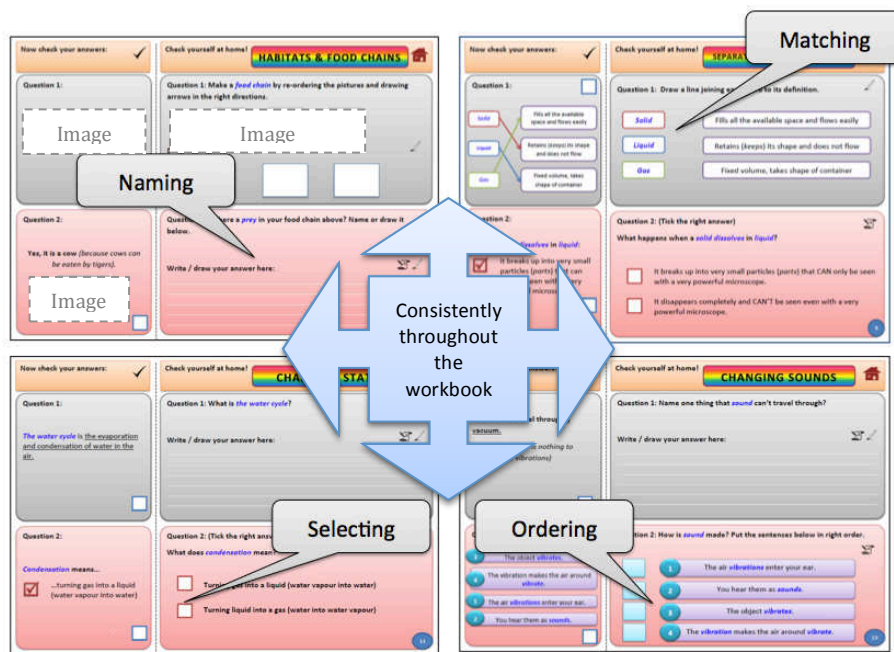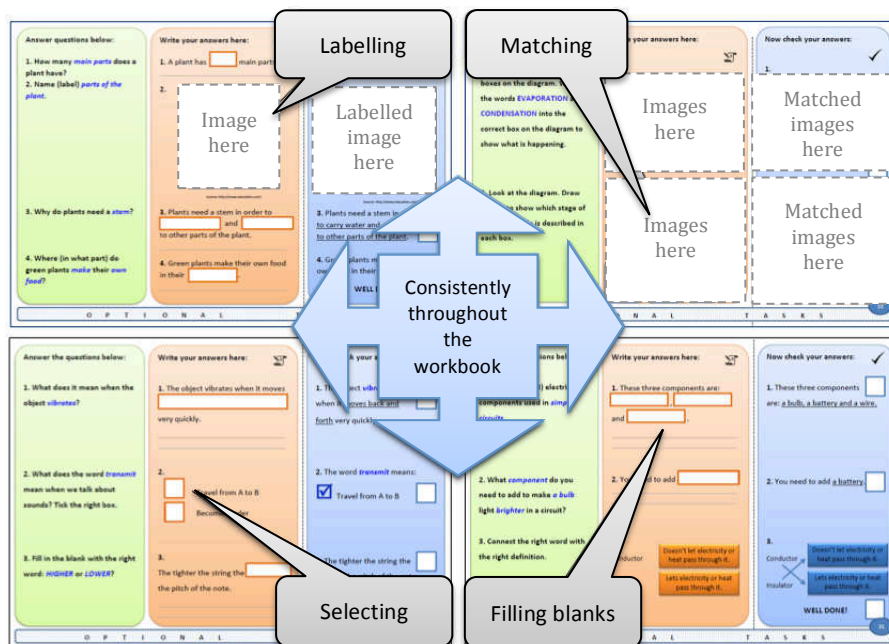
**Figure 8: Reducing linguistic demands as part of informal assessment procedures**

Needless to say, the development of such as these materials takes a considerable amount of time, effort and expertise. Ordinary teachers should not be asked or expected to develop such materials as part of their routine professional practices. The development of such materials should be a responsibility of educational authorities at the national level. In this way we are most likely to ensure consistent and high quality provision of support for EAL learners, and their teachers, in state primary classrooms in England.

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