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The architecture of website-hosted multimedia materials for the assured inclusivity of primary languages learning

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Abstract

Primary languages (PLs) learning, now statutory in Britain, requires brief, frequent sessions to be effective. This necessarily involves the support of non-specialist class teachers. However, their lack of confidence suggests the need for inclusive learning materials for use in classroom sessions. Architecting learning materials for eventual hosting on a website drew on both theoretical principles and the findings of two previous empirical studies involving primary pupils and trainee teachers. Children's sensitivity to language phonology suggests focusing on oracy, rather than literacy skills. 'Alternative codes', gestures to support pupils' recall and production, designed in a previous study, were adapted within stages of experiential learning. French pronunciation was modeled to support teachers' confidence in supporting/delivering PL learning. An empirical trial of a further language modality avoided the challenges inherent in reading and writing French, and allowed pupils to manipulate language and produce it independently. The resultant architecture of website materials is discussed.

1. Introduction

To host learning materials on a website requires drawing up a 'wireframe', a visual diagram demonstrating the materials' content, the visual layout of that content and a route through it. If the learning materials are to be effective, inclusive and

progressive, they must heed the fundamental tenets of early language learning. This paper draws on both theory and practice, in a design-based approach in order to consider what constitutes an effective PL learning environment. Since the inception of statutory PL learning in 2012 in England and Wales, patchy PL learning practice has had little theoretical underpinning. Current published online PL learning materials may not include pupils of all abilities, and class teachers tend to lack confidence in their modern language (ML) skills. However, the class teacher's role is essential in facilitating effective learning of PL speaking skills as this requires a 'little and often' approach. These contextual factors are discussed in Section 2.

Inclusive multimedia language learning materials displayed on the interactive whiteboard can potentially support both pupils and the non-expert teacher. Three broad components informed my architecting of such learning materials for hosting on a website. Firstly, the theoretical bases of inclusive PL practice are discussed (Section 3). Neurobiological theory throws into contrast young pupils' heightened but temporary sensitivity to the phonology of language with their teachers' propensity for prior learning modes, usually literacy skills. Learning to speak a language involves acquiring procedural skills, or knowing *how*; this takes time. Reflecting this, the theory of experiential learning (Kolb, 1984) recognises the learning *stages* of encounter, reflection, analysis and active experimentation with targeted language. These stages, adapted to apply to language learning (Phillips, 2010), inform the learning materials' design and are discussed in section 3.2.

A brief overview of usage-based linguistics is given, to provide a learning theory to underpin further consideration of the language learning materials' design. The premise of design-based studies is then discussed followed by reports of three studies. Findings of a previous design-based study suggested that 'alternative codes' (ACs) are effective for pupils' initial reproduction and recall of functional French (Section 4.2.1). Alternative codes, signed gestures to support pronunciation and recall, need to be adapted to meet further experiential stages of learning. To further support teachers in facilitating the learning materials, a recent study of factors contributing to teacher trainees' confidence for supporting/delivering PLs identified pronunciation as the most commonly identified factor. Clear native speaker language models were thus needed within the materials. By the time the third study (section 4.2.3) took place, learning materials for four stages of learning had already been drafted. In order for pupils to learn to manipulate the language and produce it independently, a further

modality, adapted from the original ACs, was empirically trialed by eight trainees who had learned the targeted language only using the drafted learning materials. The tenets of website construction, including the issue of written text (Section 5), inform an account of the learning materials' resultant architecture, followed by a conclusion (section 7).

2. The context of primary languages learning in England and Wales

2.1 The national context of primary languages learning

Three issues current in PL practice in classrooms in England and Wales are firstly that pupils are commonly of mixed ability. If materials are to be genuinely inclusive of these abilities, they should harness early learners' temporary sensitivity to language phonology (Schumann, 1998) see section 3.3.1). Secondly, primary class teachers' confidence in their own skills and knowledge for supporting pupils' PL learning is generally low (Rowe et al., 2012). Combining specialist teachers' subject knowledge with non-specialist teachers' knowledge of the pupils (Rowe et al., 2012) might provide support for effective PL learning. Where school staff lack confidence in their modern language (ML) skills, schools' employment of a 'specialist' who visits once-weekly in teachers' planning time is unlikely to provide an effective 'little and often' approach but rather a 'watered down' secondary school approach (Driscoll, 1999).

2.2 Primary languages practice

Despite the original prediction that PL practice would 'learn from what works' (DfES, 2002), current PL learning in state schools in England and Wales has been described as a 'huge melting pot of very varied provision' (Satchwell, 2006, p47). A previous pilot study 'French from Eight' (Burstall, 1974) started over 50 years ago, encouraged some other European countries to instigate their own PL practice but ironically, in England and Wales, was finally abandoned. When statutory PLs were finally instigated in England and Wales (DfE, 2013), a previous government's detailed guidelines (DfES, 2007) were archived and replaced with only generic ones. Thus there is currently no governmental lead on how PLs may most effectively be learned.

2.3 The provision of technologies in the primary school classroom

In British primary classrooms, internet connectivity and interactive whiteboards (IWBs) are standardly provided (Somekh et al., 2007). Thus any computer-mediated data can be displayed on the IWB in plenary sessions. Teachers in training, and therefore increasingly those in post, commonly learn to operate IWB softwares. However, the primary workforce generally lacks confidence in their potential role for supporting/delivering PLs (British Council 2015a), some having had 'disastrous language learning experiences' (Maynard, 2011). By harnessing class teachers' technical expertise to access and manipulate online supportive materials, their confidence in supporting PL learning may be bolstered if supportive learning materials to be facilitated in class take into account the teachers' needs, regardless of their language learning background. Section 4.2.2 reports the outcome of a previous study exploring factors contributing most commonly to teacher trainees' confidence for this role.

2.4 Primary languages policy in England and Wales

The latest national curriculum permits the choice of any 'modern or ancient foreign language' (DfE, 2014, p213). However, despite the perceived advantages of learning Mandarin (British Council, 2014), and the widespread use of Spanish in the world, French is still the most learned PL in England and Wales (British Council, 2015a). French is thus the targeted language in the design of the learning materials under discussion.

The National Curriculum states that 'The focus of study in modern languages will be on practical communication' (DfE, 2014, p13) but does not stipulate whether such practical communication constitutes oracy or literacy skills, or both. However, it includes a choice of ancient languages which are invariably learned through literacy (reading and writing), rather than oracy skills. Thus, in schools opting for an ancient language, pupils may not learn to speak another language. This may appease the fear expressed by professionals of poor teaching from primary generalists (DfE, 2013a) but also suggests the need to support teachers in their speaking skills necessary for practical communication.

2.5 Teachers' subject knowledge

Primary teacher trainees are commonly expected to deliver the majority of, if not all, curricular subjects through the language medium of English. Generalist class teachers can reinforce pupils' learning from specialist-delivered sessions (Rowe et al,, 2012), for without such reinforcement, little progress may be made (OfSTED, 2011). As native speakers of English, the lingua franca of the world, teachers lack opportunities to practise speaking a ML. Thus, modeling good pronunciation for their pupils may pose a particular challenge for them.

2.6 Timetabling and skillsets:

The importance of 'little and often' sessions for effective learning of speaking skills implicates the role of the class teacher in supporting/delivering this learning.

> Where possible, there should be short but frequent (in principle, daily) lessons rather than one or two longer lessons per week.
> (Blondin et al.,1998, p40)

PL teachers should also know their pupils (Burstall, 1974, p126) to pre-empt pupils' sensitivities to speaking the PL in public (Driscoll, 1999, p47). So unless class teachers are involved, pupils' speaking skills may be compromised. As previously explained, external expertise brought in tends to be on a once-weekly basis and fulfills statutory requirements. However, this results in no expectations for class teachers to provide pupils with practice of skills learned during weekly sessions.

By comparison, secondary school lessons are commonly at least half an hour in length and tend to focus on literacy skills. Because the practice of different skills develops different alacrities in the brain (Seidenberg & Zevin, 2006, p601), a characteristic known commonly as brain plasticity, teachers who learned a ML in secondary school are logically stronger in literacy skills while lacking confidence in their speaking skills. A recent study (Nuffield, 2014) advocates the importance of literacy skills for PL learning in preparation for pupils' secondary school learning. However, the temporary nature of pupils' sensitivity to the phonology of a language (Schumann, 1998) suggests that with limited curricular time for PL learning, the

generic form of language, namely its phonological form, should be prioritised over its orthographic form, whatever the teacher's initial confidence. Supportive materials should therefore develop spoken French to support pupils and teachers alike. Having briefly discussed salient issues for PL practice, the discussion turns to the theoretical underpinnings of the materials' design.

3. Theoretical bases underlying the materials' design

Three broad theories inform the design of the language learning materials. Firstly, a plausible language learning theory is identified. Secondly, because speaking a language relies to an extent on procedural knowledge, a model for the process of practising and internalising speaking skills is adapted from Kolb's (1984) four stages of Experiential Learning. Thirdly, 'understanding L2 [second language] processes in the brain constitutes the basis for any successful pedagogical approach' (Macedonia, 2013, p14). Therefore, neurobiology can provide useful insights, to clarify these processes as well as young learners' aptitudes.

3.1 Usage-based linguistics

In usage-based linguistics, 'all things flow from the actual usage events in which people communicate linguistically' (Tomasello, 2006, p439). Thus the learner maps spoken language onto experienced events, by associating spoken sounds with the contexts in which they are heard/experienced. This suggests that the French targeted in the language learning materials should be functional for use in authentic contexts. In the artificial learning environment of the classroom where events may be only simulated, the challenge is to provide a context to accompany and support practice of spoken skills.

According to usage-based linguistics theory, a characteristic of the process of learning a first language (L1) is the acquisition of specific, constructed phrases (Ellis, 2003) that serve communicational purposes in a variety of ways, and may be applied to ML learning. For example, 'I've got . . .' is a 'frame' of meaning which is invariable (and therefore easy to learn) to which different 'slots' can be added, thus 'I've got a dog' or 'I've got some sweets'. Songs can provide 'language vehicles' (Phillips, 2010) for such 'slot and frame' constructs giving useful practice for mimicry and internalising the language. (See section 6.3.1.2). This essentially top-

down process described by usage-based linguistics of learning whole sentences/phrases of functional meaning as a stream of sound mapped onto one context contrasts with the bottom-up process of learning individual items of vocabulary and subsequently building them up into functional sentences. The distinctiveness of each of these processes demands recognition of its own particular form of progress. The next section discusses the stages of progression of top-down language learning of targeted functional language.

3.2 The four stages of Experiential Learning (Kolb 1984)

In mapping language onto experienced events (as described by usage-based learning), repeated experiences of the targeted language [TL} are necessary for both memorisation and recall; these can be incorporated within sequential stages of learning for both practising different skills, and internalising the language. Phillips (2010) applied Kolb's (1984) four stages to learning to speak another language consisted of:

1. 'concrete experience': initial encounter with, or apprehension of, the targeted language [TL] item.
2. 'reflective observation': grasping of meaning while internalising and memorising the TL.
3. 'abstract conceptualisation': grasping how apprehended language items work as a system, reflecting Tomasello's (2003) view of language as 'the symbolic mapping of experienced events'
4. 'active experimentation' with the internalised TL. (Phillips, 2010, p3)

Pupils learning to speak the PL initially encounter targeted language in its generic phonological form, but because this is ephemeral, a coded form is required for further manipulation of the language. (One such code, the orthographic form, is stipulated in the National Curriculum (DfE, 2014), but without mention of the order in which the language skills should be approached.) Pronunciation is essentially important for comprehension (Khaghaninejad & Malek, 2015) and therefore clear pronunciation guides are necessary to support such learning. To form further meanings from the initially imitated sound-stream of functional whole sentences/phrases, involves the learner breaking down the initial functional sentence or phrase into smaller componential units of meaning. This may form the second stage of 'reflective observation'. Subsequently experiencing the same targeted language within new contexts allows pupils to map the meanings of the items according to the

newly encountered event. For 'active experimentation', the fourth stage, pupils' manipulation of spoken language may require a further language modality building on their prior learning. The orthographic form, itself a code of spoken language, is avoided in order to maintain accessibility to mixed ability pupils.

3.3 Neurobiology and its informing of the approach

Neurobiological findings are important for PL learning (Macedonia, 2013) for several reasons, firstly, in demonstrating the heightened but temporary aptitudes of young learners. Secondly, inclusion is particularly relevant to mixed ability primary classes where deployment of the innate skills of listening and speaking may secure a higher rate of attainment than resort to orthographic forms (see section 3.3.4). Thirdly, mirror neurons are the basis in the human brain for imitation, a facet vital for producing spoken language. Lastly, storage of words depends on how they are encountered with sensorimotor encoding posited as 'the natural way to learn L2 vocabulary' (Macedonia 2013). Limited space necessitates brief discussion of each.

3.3.1 Age and language learning – the aptitudes of the young language learner

> 'Evolution has designed the brain to acquire grammar and phonology by about four years of age through natural interaction with others. Some margin of heightened adaptability probably extends this learning period to the middle of the second decade of life. Once that period has passed, the brain can be viewed as 'damaged' with respect to the skill to be acquired.' (Schumann, 1998, p38)

Young language learners' natural aptitudes for phonology are an important consideration for inclusivity in the learning materials' design. The temporary nature of the aptitude signposts possible tensions for teachers who are facilitating the materials; because teachers are post-pubescent, they no longer enjoy the same degree of phonological sensitivity as their younger pupils.

3.3.2 Inclusivity in an effective PL approach for early language learning

Inclusivity is here taken to mean the active intention of including children of all abilities in learning activities. '. . inclusion involves the overcoming of exclusionary pressures' (Ainscow et al., 2008, p18). One such exclusionary pressure that learning theorists tend to overlook is the *order* in which the language skills of listening,

speaking, reading and writing should be learned. While accomplishment of all four skills may be the eventual desired lifelong learning outcome, the effect of each skill on each other, may not be assumed to be beneficial. For example, my previous witnessing of my pupils' (aged 9–11) French pronunciation rapidly becoming anglicised when exposed to *written* French. Because in Britain, we rarely hear other languages being spoken, the written form may be easier to access. 'Past learning always influences the acquisition of new learning' (Sousa, 2006, p138). This implies that the written form may not be undone as a mental representation. Furthermore, its non-synchronous, strongly visible form may provide easier access to the language item than the spoken form and thus supersede it when internalised into long-term memory. As pronunciation is considered to affect comprehension, and if learning moves too quickly on to orthographic forms, the requisite mastery of pronunciation may not take place.

Learning to read has been likened to brainwashing, in that seeing the orthographic form engenders an unconditioned human response (Blakemore & Frith, 2005). Whether the order of learning different language skills can have a deleterious effect is a question for future research. The oral form can be 'undone' when the learner has literacy skills which enable her/him to break down a semantic unit into component phonemes, with the possibility that the semantic impact of the original may be forgotten.

3.3.3 Mirror neurons

Due to the innate mirror system in the human brain (Warren et al., 2006), pupils' signing of 'associated codes' learned while reproducing spoken functional sentences also induce their recall of those sounds, not only when the learner reenacts them, but also when seeing the teacher's enactment (Phillips, 2010). 'When sequences of neuromotor routines are repeated, their execution becomes more fluent' (Bybee, 2006, p715). This need for repetition requires class teachers themselves to build confidence to model the ACs and they can also exploit short periods of time during the school day for 'little and often' sessions. In my previous study (Section 4.2.1), two of three class teachers had not joined in with my modeled ACs and subsequently lacked confidence to model the codes themselves. Participation in enacting ACs is required in order to exploit the mirror system in our brains. My use of ACs supported all

participants' spoken production across the ability range in the heightened challenge of publicly speaking French with native speakers via videoconferencing (op.cit.). The question arose as to whether a further adaptations of ACs would appeal to pupils' innate capabilities. Their 'reading' or decoding of a still image of the ACs for further independent practice of language is discussed in section 4.2.3.

3.3.4 Storage of language

The merging of phonological and gestural circuits in early language evolution (Aboitiz & Garcia, 2009) signifies the innate facility for the use of signing to support spoken language. '. . .words in L2 should be learned by involving all sensorial channels as well as the body' (Macedonia, 2013, p5). Gestures and signing use the same innate aptitudes hardwired after 3.5 million years of human evolution, in alternative codes. In contrast, the commonly used orthographic form has to be learned for several years. Involving both brain hemispheres in undertaking ACs, retention of language is likely to be greater when using ACs rather than merely orthographic coding (Catani et al., 2007).

Amongst several foundations considered 'crucial' for children's early language development, music (DfE, 2011, p39) can provide a 'language vehicle' (Phillips, 2010) to help memorisation of functional questions and answers.

> 'Specific links exist between high levels of music training and the ability to manipulate information
> in both working and long term memory; these links extend beyond the domain of music training' (NeuroEducation Initiative, 2009, p13)

Auditory-motor interactions in the brain (Zatore et al., 2007) demonstrate the considerable potential of using both music or spoken word concurrently with ACs. This strongly suggested the inclusion of a song in the learning materials in the first stages of encountering the targeted language.

4 Design-based studies

4.1 Design-based methods

Design-based research is an increasingly adopted paradigm particularly for educational research; it can 'bridge the chasm between research and practice in formal education' (Anderson & Shattuck, 2012, p11). It encompasses both the cyclical stages of action research and the generation of grounded theory from studying particular situations. Analysis of data gathered at the end of each cycle informs the next cycle of empirical study. It is thus essentially a study of processes which informs the subsequent designs of materials and/or learning environments and incorporates theoretical perspectives in its discussion and practice. This paper draws on the theoretical bases (discussed in section 3) relating to young language learners as well as previous empirical studies both of pupils' learning (Section 4.2.1), and of factors contributing to teacher trainees' confidence (Section 4.2.2). The findings of these studies informed the design of the learning materials for the purposes of effective learning materials for both learners and teacher alike. A trial was undertaken of a further modality, in lieu of the orthographic code, in an empirical study of the fourth experiential stage of learning for pupils. Because eight trainees participated in the trial, data was gathered in both informal conversation as well as notes in a research journal of their perspectives about both the learning materials employed, and their own reactions to it. The design-based cycle thus served 'applied as well as theory-building purposes' (Reimann, 2011) to inform the architecture of the stages of PL learning to be hosted on the website.

4.2 Studies informing the materials' design

4.2.1 Study 1: Inclusive strategies for supporting mixed ability pupils' speaking of French

A case study of the preparation of primary school pupils for spoken exchange in French with peer native speakers via videoconferencing (Phillips, 2010) intended to involve three class teachers' collaboration in 'little and often' plenary practices with their classes of my brief weekly specialist input. Despite witnessing these weekly sessions, two of the three teachers lacked confidence to lead these practices

themselves. The use of ACs developed within Study 1 served to meet the needs of all pupils, some with Special Educational Needs, within the time constraints of my weekly brief (20-minute maximum) sessions. One notable success was illustrated when a boy who was selectively mute at school, participated in speaking French to native-speaker peers via videoconferencing, with my occasional silent signing of the ACs to support him. As two non-specialist class teachers needed more rehearsal time to build skill and confidence for this supportive role, learning materials modeled ACs so that teachers could also practise them in their own time (section 6.3.1.3) as well as alongside their pupils. While these stages provide opportunities for pupils and teachers to imitate and reproduce spoken language, a further 'active experimentation' stage of learning was trialed in Study 3. Study 2 was undertaken at a later stage (see the next section) to gain further insights into the teachers' needs.

4.2.2 Study 2: Factors contributing to teacher trainees' confidence for their future role in delivering/supporting PL learning

As university tutor of 2 cohorts of primary school teacher trainees undertaking a unit on PLs during the second of a 4-year undergraduate degree (2012), I undertook a study of factors contributing to their confidence as future teachers delivering/supporting PL learning (Phillips 2014). During their course, they were encouraged to reflect both on theoretical principles, and PL learning practice simulated in sessions. Few of them witnessed PL learning in the schools in which they were placed. Throughout 11 unit sessions, I collated issues raised by the trainees themselves in discussions. I restated the issues in a final questionnaire (appendix 1). Trainees then graded the significance of each for their confidence as future teachers supporting PL learning. The most commonly identified factor was pronunciation. In trainees' reports of their secondary ML learning, the majority learning for only 3 years, speaking practice had often consisted of reading prescribed sentences aloud, but with no explicit learning of phonics rules to support good pronunciation (Phillips, 2014). The third most commonly identified was 'having the vocabulary I need written down'. The focus on literacy skills in trainees' own ML learning at secondary school may have instilled this particular reliance in them. 'When print is in front of your eyes, you are compelled to read it' (Blakemore & Frith, 2005, p72). Reading is thus likened to brainwashing, in that it triggers humans'

conditioned response which cannot be undone (op.cit.). Trainees' reliance on the orthographic form for recall of vocabulary, during group presentations was apparent and recalls Plato's warning that reliance on writing was a 'recipe not for memory, but for reminder'. As trainees commonly decoded using English phonics, rather than French, the orthographic form did not support pronunciation for the majority of them. The use of ACs helped break some trainees' habits and improve their pronunciation and recall. However, only just over a third of them using such a strategy in their presentations. Thus where Study 1 showed ACs' efficacy for pupils' learning, they were the fifth most commonly identified factor contributing to trainees' confidence. This suggested trainees lacked either belief in the ACs' efficacy, or the time commitment to practise them, or both. Study 3 describes different outcomes for trainees collaborating in learning and using ACs with groups of pupils.

'Accepting that making mistakes is alright' was second most commonly identified. This is possibly a gendered trait; a report claims that fear of making mistakes underlies young females' failure to achieve their full potential, particularly in A-level exams which are important for university entrance and job prospects (Bedford 2013). As over 90% of trainees were young females, mistake-making opportunities were needed within the learning materials (see section 6.3.1.1).

4.2.3 Study 3: a trial of an alternative modality by teacher trainees' facilitation of school pupils' spoken French

Study 3 took place in 2015 when the architecting of learning materials had been developed to four draft stages of learning, outlined in section 6.3.1. The apparent need for a further learning stage for pupils to actively experiment with targeted language and gain independence required a further modality built on pupils' prior learning. Therefore, I designed 2D still images encapsulating the ACs learned alongside spoken French (examples in appendix 4). These were then trialed in an authentic classroom situation to gather both trainees' and pupils' responses. Whereas in Study 2, most trainees did not readily choose to adopt ACs, in study 3, another group of eight 2nd year undergraduate teacher trainees choosing PLs as a specialist study undertook the stages of experiential learning as part of their course. I gathered their reactions to using the ACs and the 2D still images through informal conversation

recorded in my learning journal. Additionally, they collaborated with me in trialing this further modality amongst pupils (aged 8/9) in school.

All these trainees had learned some French at secondary school, but claimed to have forgotten it since. Unlike the non-specialist trainees in Study 2, these trainees learned to speak the functional French question and 7 possible answers using only the learning materials. Orthographic forms were not used, although they could all access the written vocabulary if they wanted. Using ACs as both mnemonic devices and to support pronunciation, trainees engaged in learning the song or 'language vehicle' (see section 6.3.1.2) downloaded onto their phones, and participated in 2 x 10-minute session of learning and practising the ACs and watching animated forms of them. One trainee who had learned only German and initially struggled to read or pronounce French words, regularly practised the song and reported increased confidence and recall. I led trainees' sung and spoken practice of 'On est quel jour aujourd'hui?' and seven possible answers using ACs in two 10-minute sessions. On each occasion, I later heard the trainees singing the song quietly to themselves between lectures. Despite being asked to practise the ACs daily by copying them from videos, all of them confirmed that they had already internalised the language and ACs during the two 10-minute university sessions. This suggested the efficiency of time of this way of learning for the trainees, once committed to learning the spoken language.

During an initial 30-minute session with a group of 42 pupils aged 9/10 in a primary classroom, I taught pupils the song, then the spoken form of the same language accompanied by ACs. A week later, I recapped the same activities with the pupils for the first 10 minutes. Subsequently, pairs of trainees took groups of 4/5 pupils to sing the song once again alongside the accompanying ACs. Then, using the 2D still images, pupils were asked to recognise and reproduce the spoken form associated with each image. Through informal discussion, feedback to a colleague, and brief questionnaire answers, trainees' perceptions of both their own learning, and of pupils' response to the 2D images were gathered. Apart from one boy's general recalcitrance in the session, the trainees reported pupils' invariably successful recall of language through using ACs, as well as their own confidence in modeling them. Lack of time constrained the gathering of exact data about the pupils' ability range but the class teacher reported the participating pupils were of lower ability. As one boy asked whether the signed ACs always accompanied spoken French, it was noted that an explanation of the strategy should have been given. All trainees reported that all

the children had 'read' aloud the still images instantaneously. The images therefore performed the role of a 'literacy', their effectiveness for recall of spoken language used by trainees facilitating pupils' learning advising their incorporation as a final stage of experiential language learning. They were decoded into spoken form and could be encoded to make new meanings.

Although the trainees' questionnaire responses may have been skewed due to our tutor/student relationship, three students' spontaneous fed back to a colleague of mine that they had enjoyed the afternoon in school and boosted their confidence in delivering/supporting PL learning. This feedback achieved a degree of triangulation of data.

4.2.4 The limitations of the design-based study

The gathering of trainees' opinions was time-constrained, as their course of study is already intense. Questionnaires could be completed quickly, but did not always gain a depth of insight that could be available from other methods, such as interviews, for example. Furthermore, as I was materials designer, with some personal time investment in the learning materials, there is the likelihood of insider bias. However, Study 3 was empirical and trainees' responses to the experience, including the unasked feedback to a colleague was significant in demonstrating the positivity of their own experience. Also, the neurobiological underpinning of the materials' design ensured their theoretical rootedness. The study could not be compared with reference to other studies due to its exploratory nature and innovative stance. However, where possible, reference has been made to literature pertinent to PLs learning in England and Wales.

5 Website construction

Drawing on the findings of all three design-based studies, the discussion now turns to the technological hosting of the materials; consideration of its requirements was concurrent with the processes of design discussed in previous sessions.

5.1 The precepts of website construction

> ‘ . . technology need not enhance and often considerably diminishes language learning where it is misapplied.’ (Milton, 2001, p18)

To avoid any such misapplication in hosting learning materials on a website, as materials designer, I negotiated factors with the website constructor which included the norms of website construction, the technological capabilities and their interface with the human user.

5.1.1 The technology’s capabilities

The website hosting of language learning materials for plenary use depends on the transmission of multimedia data and a means to display them in the classroom. Interactive whiteboards (IWBs) can support teaching and learning though teachers need training to make best use of them (Phillips, 2010: Hennessy and London, 2013). By 2009/10, 67% of primary schools reportedly had IWBs in place (Becta, 2009). Because of currently common use of the Internet at home and of mobile devices in locations with wifi, class teachers commonly access the Internet with ease.

Written text in the layout of websites, not only as content, but also for navigational purposes, raises the challenge of its use in PL learning materials focusing on oracy, rather than literacy, skills. Human interface with the computer through intelligent voice recognition, thus far yet to be normalised, is still largely accent-sensitive and reliant on high quality audio input. Thus, even within a prescribed language, it currently needs considerable further development for use in learning a ML. Any interactivity within the learning materials’ design is therefore constrained to opportunities for repetition, at least until intelligent voice recognition is commonly available. While the learning focus is on spoken language, pupils essentially respond to, rather than interact with, the materials and technology. However, multimedia data is now easily captured and edited in commonly accessible format, so that modeling of spoken French and ACs is easily supplied. ‘Leap motion’, an interface currently under development, tracks, emulates and thus ‘reads’ movement. Through preprogrammed association of such movement with meaning, as in signing, ACs might also be ‘read’ and understood in future materials’ designs.

5.1.2 The propensity for commercial accessibility

In the initial conversation, the website constructor required a 'look' for the website, possibly as his normal involvement was in the commercial sector; this may have promoted his foremost consideration of the website's visibility in the market and the frequency of access to judge the materials' effectiveness. Pointing to several commercial PL learning websites, his initial request was my choice of a website to emulate. However, such websites almost invariably resort to written language for pupils' independent work, possibly also accompanying spoken forms in *presenting* the targeted language. While these materials might prove accessible for certain pupils, lack of pronunciation support targeted a different skill base for learning. They therefore lacked inclusivity.

5.1.3 Accessibility regulations for website design

Statutory guidelines for website construction (Worldwide Web Consortium (W3C), 2015) stipulate clearly that accessibility should apply to all users, regardless of their disabilities, where possible. For this reason, written text is the medium of website navigation, its absence considered unethical, as it denies access, at least to those without visual impediment. 'Provide a text equivalent for every non-text element' is a stipulation (W3C, 2015) that text should accompany all non-text items, including 'stand-alone audio files, audio tracks of video, and video' (op.cit.). Despite the intentional avoidance of text within the learning materials, regulatory usage of text for labeling content is demanded, even though all areas may be labeled by graphic images. While labels written in French may better match the content to be learned, it may also exclude teachers facilitating learning materials. Therefore, the inclusion of tips for teachers on each website page can explain in English the language content and how to use the materials. For vision-impaired users, certain softwares such as ReadandWrite can provide spoken audio of written text, but there is no guarantee or stipulation that primary schools have purchased this software. The statutory ethical guidelines could thus be construed to be partial in favouring the sighted.

5.1.4 Norms for navigation

The precedent for languages to be represented in alphabetic code is changing (W3Ca, 2015). Representations in codes other than the alphabet have hitherto been adapted into alphabetic representations; Pinyin, for example, represents Mandarin phonemes in alphabetic code, rather than the semantic characters normally used in Chinese. However, such representations cannot convey the language's phonological nuances, thus jeopardising the learner's understanding when exposed to native speaking. For European languages sharing the same alphabetic code, such as French and English, pupils' likely reading of written French labels uses their English phonics. Ideally hovering the cursor over the written word, a phenomenon known as 'rollover', could elicit the spoken form but is an expensive option to implement. Website labels provided in French on the videos all have spoken form dubbed over them.

5.2 Concepts for negotiation of website structure

Two particular processes for web design, namely workflow and wireframe, are discussed.

5.2.1 Workflow

Workflow constitutes agreement on the content to be hosted as well as working terms negotiated between website constructor and client (but the latter are omitted from this paper's discussion). Having identified and discussed learning principles intended to underpin the content of the learning materials, their hosting on a website required consideration of how these principles might interface with the human senses. I noted the predominantly visual bias of many published PL sites where sophisticated imagery engages its audience. Audio data, arguably less dominant, by comparison, is essential for supplying the phonological input that matches young learners' heightened sensitivity. Therefore its status amongst the learning materials is important. The accommodation of ACs essentially involves human movement, suggesting that moving image is required to capture them. Multimedia data in the form of mp4 files is compatible with most computer operating systems and can capture the real-life contexts from which pupils can formulate meanings.

5.2.3 Wireframe

The wireframe, or schema, developed to optimise the users' experience and 'solve the user problems' (Witkowski, 2015) needs 'a boilerplate or template of sorts' (op.cit.). This template should not only follow the norms for website navigation but also identify a consistent path of progression through the materials. Thus the order of experiential stages of learning (section 3.2), and the type of media and content which provide those stages, are all relevant to constructing a wireframe.

In some learning processes, the sequencing of activities may be paramount for successful learning. This assumes that cognitive demand has to build on some foundations of understanding. Furthermore, some additional activities may be tangentially undertaken to support a particular learning need, before returning to the main learning path. However, the PL learning materials are largely based on performed experiences, and like all skills, need to be undertaken a little and often in a mode of progression signified by the degree of reliance/independence, both for recall and self-image. Certain conventions for navigating a website, such as home button top left and search top right, are unlikely to affect navigation within the learning materials, as the user is likely to return to the homepage or starting place. This is due to both the basic level of language involved, and also the division of content into separate language functions represented on the homepage as separate images (see appendix 4). The user thus does not stray far from the homepage which, in line with industry standards, should never be more than three 'clicks' away from any part of the website. As progress involves deeper internalisation and recall of the language, each stage of learning may be found easily within a straightforward wireframe.

6 Architecting the materials in concordance with the website construction precepts

This section reports on the considerations for architecting the inclusive materials ready for their hosting on the website.

6.1 The technology's capabilities

The hosting of different formats of data enabled the use of still images, audio recordings, moving animations, as well as video footage amongst the materials. User-friendly and publicly accessible softwares also helped me to edit such material. Having previously experienced compatibility issues between Apple computers and PCs in audio content, no such problem was encountered when either exporting audio as mp3 files, or uploading multimedia mp4 files.

6.2 The use of written text only for accessibility and navigation

Use of written text to meet ethical requirements for website hosting was kept to a minimum by four means. Firstly, usage-based linguistics requires direct meanings supplied by images. Secondly, accompanying images, consistently and strategically placed, further categorised the language's function. (Appendix 2 images denote whether sentences are questions or answers). Thirdly, for language items such as days of the week, still images were adopted of the ACs that had been used to learn them (in appendix 3). Fourthly, each question and answer language function depicted on the homepage was labeled only in small print on the top menu bar (appendix 3).

Navigating the stages of learning within each language function required a panel at the side of each webpage; several of the French words are English cognates and therefore easily understandable. The activation of the spoken French form with 'rollover' was ruled out due to its expense. However, instructions to guide the use of video clips are portrayed as written acronyms with dubbed recorded French. For example, a spoken 'faites les gestes' is represented simply by a 'G' onscreen.

6.3 The design of the content

Initial consultation with a website developer failed to pinpoint the important idea that the 'route' or wireframe for the user's experience must be consistent, otherwise, users may lose their way. The learning stages are therefore equivalent within each language function represented as an image on the homepage (see appendix 4). As explained in the previous section, the content was designed on the bases of both usage-based language learning set within stages of experiential learning, largely guided by previous empirical studies. Having established the successful use of

ACs for pupils in study 1 in initial engagement with spoken language, their progression to the latter experiential stages required solutions, including a further language modality, discussed in section 4.2.3.

6.3.1 The five stages of learning

Certain learning stages undertaken to speak a language increasingly independently have drawn on experiential learning to describe that progress; they are discussed in the following sections.

6.3.1.1 Taking risks and guessing

The need for pupils and teachers to take risks, not yet catered for, suggested video footage of spoken French (section 6.3.1.1). Preempting and amplifying the stages described previously, video clips containing the spoken targeted language provide a context for each function of 'question and answers' on the website. Children learn better when they have to deduce the meaning of language, assuming sufficient clues are given (Cameron, 2001). Video clips provide pupils with opportunities to guess the content common to a few conversations, by employing all the multimodal literacies at their disposal to understand facial expression, intonation and body language, as well as listening to repetitive expressions in French. In the video, a professional actor ably externalises such aspects. Mistake-making is thus an implicit part of the guessing activity. The class teacher's responsibility is to hide as far as possible the written clues for each language function, while encouraging listening, watching and guessing.

6.3.1.2 A language vehicle

To learn the motor skills for actively imitating the pronunciation, a song which includes both question and answer is next presented. Music training can support children's linguistic ability (Moreno et al., 2008, p712; Good et al., 2015, p27). While there is an argument for pupils' explicit understanding of meaning when speaking another language (Cameron, 2001), the purpose of this purely auditory material is to allow pupils to concentrate on imitating sounds, possibly aware of its functional application. Analysing the meaning of its component parts occurs later, as in usage-based linguistics. Firstly, a slow-speed echo track allows pupils to learn the song,

while mastering any challenges of pronunciation. Subsequently faster tracks encourage pupils' greater automaticity in producing spoken/sung question and answers. Catchy tunes aim to emulate the intonation patterns and natural rhythms of the spoken language. Thus, articulacy (the motor skills for producing appropriate sounds) is rehearsed in this stage of learning. While other PL songs occasionally employ an already well-known tune, presumably to ease the learning process, they potentially distort the language's natural rhythm and intonation. Furthermore, the original words of a tune may override memorisation of any new words set to that same tune.

6.3.1.3 Reflective observation

Transfer of memory to working memory (Sousa, 2005, p47) through learning 'associative codes' while imitating the sounds, reinforces a strong association between the sound and code. This opportunity is provided in a demonstration of the ACs modeled by a native speaker of French. This stage represents an initial encounter with the ACs, while learning spoken sounds originally sung in a song. Honing pronunciation and further consolidating the lexical item in its spoken form, the mirror system (see section 3.3.3) is then exploited to practise ACs; firstly, the modeled spoken form elicits pupils' ACs. Subsequently, the enacted AC is modeled to elicit pupils' speaking. A further practice video provides opportunities for exercising the mirror system in this way.

6.3.1.4 Animations

Enacted ACs were depicted and animated to provide a further representation of spoken language. Alongside them, close-up video of the native speakers' lips provide a clear pronunciation guide, to meet trainees' identified needs for building confidence (see section 4.2.2). Native speakers' modeling provides authentic pronunciation models, with both French and Belgian models employed. This further provision of animations emulating the ACs provides a further abstraction of form so that pupils can check their understanding and execution of the language learned thus far.

6.3.1.5 A further modality

The 2D still images trialed in school (described in study 3) enabled pairs of pupils to recall and manipulate spoken language by reordering the different images to

make sentences with the images and then speaking them aloud. With teacher/pupil ratios commonly as high as 1:30 in primary schools in England and Wales, the opportunities for pupils to use spoken language in authentic exchange of information are rare unless pupils actively experiment independently of the teacher. Further provision for such exchange is made within the choice of functional content of the learning materials. Information likely to change on a daily basis, for example, weekday names, and the weather, constitute the language functions chosen for the learning materials. Such information may then be exchanged in French.

7 Conclusions

Providing language learning materials to support learning for mixed ability primary pupils as well as their class teacher who may lack confidence in their own ML skills requires acknowledgement of pupils' innate abilities for speaking and listening, and subsequent stages needed to internalise their learning to speak French. Findings from previous design-based studies noted the efficacy of pupils' use of ACs to support their learning. However, one cohort of trainees, given a choice of how to learn more French, resorted to previously learnt written resources which failed to support their pronunciation. Other trainees identified pronunciation as an important factor for their confidence. A third study demonstrated that if trainees learned to speak functional French using the ACs, they could build their confidence and improve their pronunciation.

Cycles of redesign of inclusive language learning materials identified the lack of opportunities for pupils' independent practice. Designed 2D still images of animations of ACs were trialed in authentic circumstances by 8 trainees who had learned the French only through use of ACs. Nineteen of twenty mainly lower ability pupils decoded the images to produce spoken language. Opportunities for risk-taking were incorporated within videos which put the language into context of usage of spoken roles for functional language exchange, as question and possible answers. These dictated the learning materials' subject matter. Subsequent stages of learning provided progressive learning in a top-down approach. Pronunciation demonstrated through close-ups of native speaking of French should help teachers' confidence. Inclusivity dictated use of imagery on the website to avoid written text as far as possible, though heeding website requirements for navigation and access. Echo tracks enabled pupils' mimicking of sung language.

Further research is needed to trial the materials within other schools, including the progression from learning to speak the language in this way, to reading and writing it. Comparisons of the effectiveness of this 'literacy' of 2D still images for pupils' construction of new meanings, against that of the written form, would help to indicate both the time efficiency of alternative strategies, and pupils' motivation to learn. Signing and gesture, hardwired in the human brain, are strategies accessible to all, but there seems to be some resistance amongst the workforce to the belief that it works, and to the idea that it requires 'little and often' practice.

Appendices

Appendix 1

Tick the column that represents most closely your viewpoint, where 1 = strongly agree, and 5 = strongly disagree and unD = undecided.

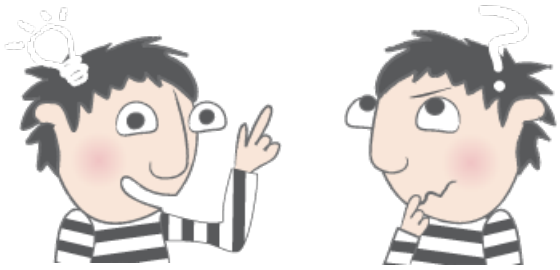
My confidence in teaching ML (would) depend(s) on	1	2	3	4	5	unD
the pupils' confidence						
the language skill that I am teaching (L S, R or W)						
how well I know the pupils in the class						
the pupils' attitudes towards ML learning						
having the vocabulary I need written down						
having a scheme of work to follow						
keeping the sessions short						
having worksheets for pupils to do						
how well I can pronounce the words						
the support/enthusiasm of the other teachers						
someone else providing the language role-model						
using appropriate methods/approach						
pupils having a dictionary to find out words						
taking the class without other adults looking on						
my adopting a different persona e.g. a puppet						
worksheets to provide correct spelling						
accepting that making mistakes is alright						
finding a website with good games						
having a translation of the words into English						

using English to conduct the lesson, not the TL						
using actions to help pupils recall sounds						

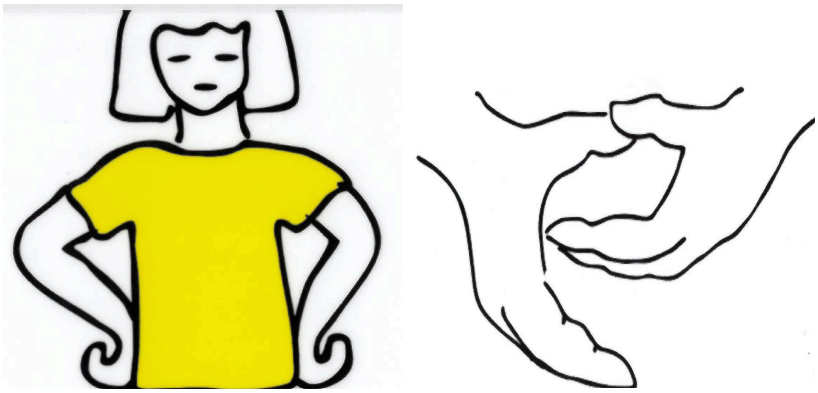
where L – listening, S – speaking, R – reading, W - writing

Appendix 2

the answer icon the question icon to denote the language function



Appendix 3 Still images of the ACs for ‘jeudi’ and ‘c’est’



Appendix 4 image to denote a separate language function for ‘jeudi’ and ‘est’

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