ðə dʒərnəl əv læŋgwədʒ titʃɪŋ ænd lərnɪŋ

J L T L

dɛdəketəd tu haj kwələti risərtʃ ɪn əplayd lɪŋgwɪstɪks

http://www.jltl.org/jltl/

The Journal of Language Teaching and Learning, 2013–1, 54-68

Augmented Reality Potential and Hype: Towards an Evaluative Framework in Foreign Language Teaching

Jessica Salmon[1] & Julianne Nyhan[2]

Abstract

Augmented Reality adds a layer of digital information to a live direct or indirect view of a real-world environment. Of late, many claims have been made about the potential of augmented reality software in education. Technically such software may offer many exciting features but little research has been done into the teaching and learning foundations upon which it is built. This is problematic because in a time of budget cuts, on the one hand, and ever increasing examples of such software, on the other, educators do not have available to them an objective framework that they can use to evaluate the potential pedagogical usefulness of such software. Furthermore, technical developers have little guidance as to the pedagogical expectations of educators. By focusing on the area of foreign language teaching this article takes a first step towards addressing this research gap by proposing an evaluative framework that has been constructed with reference to teaching and learning scholarship, as opposed to that of digital humanities or computer science. It tests this framework using a series of case studies dealing with existing augmented reality applications for language teaching and learning and those which could be repurposed. It concludes that the evaluative framework created in this study has established a potentially useful baseline for making decisions about the possible use of augmented reality applications for teaching and learning in the classroom. We hold that the integration of such a framework with existing digital humanities and computer science methods of evaluation may result in a more objective and interdisciplinary framework that can be used for the evaluation of such software.

Keywords: Augmented reality; Assessment; Foreign language teaching and learning

1. Introduction

'… [C]omputers and computing … have always been surrounded by hype (it was – and may still be – the only way to sell them),… '(Mahoney, 2005, p. 120). This article argues that the pedagogical effectiveness of Augmented Reality (hereafter AR) software for language teaching and learning cannot, at present, be objectively assessed or predicted because it continues to be discussed in terms of perceived potential and hype. In order to effectively and objectively evaluate such software it is necessary to begin building evaluative frameworks that are firmly rooted within the scholarship of teaching and learning. This is not to say that technological considerations are not important, for

[1] Universitaet Trier, Germany. Email: jessiesalmon@hotmail.com

[2] University College London, United Kingdom. Email: j.nyhan@ucl.ac.uk

example, calls to ensure that software is non-proprietary and open source are important too. Nevertheless, it is clear that teaching and learning scholars have a unique perspective to bring to this debate in order to move it onto a more objective footing.

2. What is Augmented Reality?

Augmented Reality (hereafter AR) adds a layer of digital information to a live direct or indirect view of a real-world environment. This additional information may include graphics, 3D images, audio or GPS and produces a new view of the world for the individual using it. AR requires some kind of action from the user to see its effect; for example, by holding a smartphone up to a view or waving it over a newspaper, or physically moving in front of a display screen.

AR differs from virtual reality because it does not replace the real world with a synthetic environment. Milgram's Reality-Virtuality Continuum describes how these different types of reality relate to each other. In this continuum, AR lies in the region called mediated reality, between the physical environment and an entirely virtual environment. Mediated reality includes augmented reality, which lies closer to physical reality, and augmented virtuality which lies closer to virtual reality (Milgram et al., 1994).

The idea of augmented reality has existed for more than 40 years. Ivan Sutherland's essay 'The Ultimate Display', written in 1965, which ends with the vision: 'with appropriate programming such a display could literally be the Wonderland into which Alice walked,' (Sterling, 2009) has been described as the 'seed bomb' for augmented and virtual reality technologies (Sterling, 2009). However, it is in the last few years only that technology has caught up with the idea of augmented reality as devices have become cheaper, smaller and sufficiently powerful to run applications. Smartphones, webcams, digital projectors and head-mounted display units contain all of the elements needed to run augmented reality applications.

AR has already been put to varied use in industry, services, entertainment and cultural heritage organisations and in some sectors it is already a mature technology. For example, it is used in the military for aviation systems: 'for many years, military aircraft and helicopters have used Head-Up Displays (HUDs) and Helmet-Mounted Sights (HMS) to superimpose vector graphics upon the pilot's view of the real world' (Azuma, 1997, p. 9). More recently it has featured in military operations in urban terrain (Livingstone et al., 2002) and for urban skills training (Brown, 2006).

In 2009, Fraunhofer IGT blurred the line between tourism and education when it created a table-top and a mobile AR sightseeing application which displayed 3D images of the urban development of Berlin from 1940 to 2008. The ability to enhance the real world in this way has already been used to great effect in cultural heritage organisations and in museums. Archeoguide (2002) is 'an augmented reality-based cultural heritage on-site guide'. It is designed to enable people to 'see' historical ruins as the full building which they once were. The Natural History Museum's award-winning[i] interactive film 'Who Do You Think You Really Are?' used augmented reality to guide people through their evolutionary past, including 3D animations of dinosaurs and early man (Natural History Museum, 2011).

It is clear that despite augmented reality's long existence, there is still some disagreement over its definition – due mainly to the fact that AR is still evolving and its uses are still being explored.

R.T. Azuma's definition is well-respected and established. It states that an AR system must have three characteristics: it must combine the real and the virtual, be interactive in real time and register in 3D (Azuma, 1997). Eric Klopfer, an expert in the uses of AR for education, offers some additional ideas for a definition of AR: 'while others narrowly define this space to include heads up displays using helmets and goggles with precise positioning providing real time visual overlaid information, we use the term broadly enough to include location-based games on handhelds and mobile phones which provide additional virtual data or information at given locations' (Jenkins, 2008).

Robert Rice, CEO of Neogence Enterprises and Chairman of the AR Consortium, adds a further dimension: 'Some people prefer a narrow and limiting view (3D overlaid on video), but I think in

terms of the market and the end-user, it is better to have a wider definition. In that sense, AR is purely the blend of real and virtual, with or without full 3D overlaid on video.' (Shute, 2009)

This study defines AR broadly so that no appropriate AR application is excluded from analysis. On the one hand, as Azuma, Klopfer and Rice agree, it must provide an additional layer of information, enhancing our view of the world. In order to ensure integration with the real world, it should also conform to Azuma's second characteristic ('be interactive in real time'). On the other hand an AR application need not necessarily register in 3D, nor should it be limited to a single type of hardware.

3. What is being said about Augmented Reality?

In 2010 augmented reality reached number four in *Time* magazine's 10 Tech Trends list (Fletcher, 2010) The BBC recently reported that it 'looks set to become a serious commercial tool'(BBC News, 2011). More recently, augmented reality has been widely tipped as the 'next big thing' in education.

The New Horizons Report 2011 states that augmented reality 'is shifting from what was once seen as a gimmick to a bonafide game-changer' (Johnson et al., 2011, p.16) in education. Kieron Kirkland of Futurelab Research argues that 'AR gives students the potential to go out and experience learning in a completely new way. It's potentially enormously powerful.' (Futurelab, 2010, p. 6) Moreover, AR is believed to have the 'wow-factor' (Specialist Schools and Academies Trust, 2009) needed to engage pupils in learning. Peter Scott, Director of the Knowledge Media Institute at the Open University, believes that 'using AR to literally put information into their [students'] world gives them a huge advantage' (Scott, cited in Futurelab, 2010, p. 3). But is putting even more information into a student's world implicitly a huge advantage? Indeed, the refrain of our times seems to be that we are overwhelmed by information. Thomas Carpenter's blog entry '7 Ways Augmented Reality Will Change Your Brain' provides a darker interpretation of how AR could affect our everyday lives: distracting us, giving us so much information that we make bad decisions and causing us to over-think an activity that relies on gut instincts (Carpenter, 2010). While Gartner's *Hype Cycle for Emerging Technologies 2011* states that augmented reality has moved quickly in the last year and is already starting its descent towards the trough of disillusionment: 'augmented reality has jumped over the peak [of its hype] as initial demos and pilots give way to the challenges of large-scale implementation.' (Fenn & LeHong, 2011)

It is clear that we are still in the very early stages of AR take up in the educational sector. Yet, the survey that we carried out for this paper of the AR language learning landscape indicated that at least eight resources are currently available. A representative selection of resources ranging from those aimed at primary school to third-level education are discussed in the 'Augmented Reality Applications: Case Studies' section below.

4. Towards an Evaluative Framework

In this section we discuss five exemplary articles that examine effective language teaching and learning and/or the role of technology in order to build a prototypical evaluative framework and test its applicability. We begin with an overview of five articles we have identified; we go on to collate the general theories about effective language teaching and learning that they present. This is followed by a discussion of more specific points regarding language teaching and the role of technology which can be drawn out of the articles.

The five articles reviewed provide a broad overview of the issues that surround language teaching and learning and the role of technology in the classroom – this includes general language teaching and learning theory; cognitive theory; a review article on technology in language pedagogy over the last century, as well as best practices for ICT in language teaching and learning and Computer Assisted Language Learning (CALL) research.

Lightbown and Spada (2006) investigate the effectiveness of various second language learning theories in the classroom in chapter 6 of their influential book *How Languages are Learned*. This chapter does not deal with technology but proposes a 'best practice' model of language teaching. It also demonstrates that the other theories explored are beneficial for certain areas of language teaching and learning but if used in isolation cannot provide a comprehensive teaching and learning experience.

Boettcher (2007) outlines ten core principles for designing learning environments. These principles are informed by research findings about how our brains work and specifically address the high technology environments in which we all live and work. Although this article does not deal specifically with language learning it is one of the more up to date articles to examine pedagogical theory in relation to today's hi-tech learning environments.

Salaberry (2002) deals specifically with the role of technology in second language teaching and learning. His review article examines the proposed pedagogical use of different types of technological resources throughout the 20th century. He then discusses the wide range of pedagogical aims for technology, provides a final assessment of the role of these tools and provides some important observations about technology-assisted language learning.

Hoppingarner's article 'Best Practices in Technology and Language Learning' establishes that technology already has a place in language teaching and learning and that 'the question regarding the use of technology to support language teaching has shifted from 'whether' to 'how'' (2009, p. 222). Hoppingarner proposes a series of best practices in this realm which take into account 'effective language pedagogy and appropriate roles of technology' (2009, p. 222).

Finally, Kern's (2006) article discusses the way in which communication technologies have changed language pedagogy and language use. He examines key issues arising from technology-related literature and examines the implications for teaching and research. His article focuses mainly on the status of CALL and less on how technology should be used for teaching in the school classroom. However, CALL research makes up a large part of the research about the role of technology in language teaching and learning, thus it would be remiss not to make use of this area of research.

5. Theories for Effective Language Teaching and Learning

Lightbown and Spada conclude that the 'Get it right in the end' proposal for second language learning in the classroom is the most effective method. This proposal acknowledges the importance of drawing attention to the forms and structure of the language but also recognises that it is not necessary to teach everything explicitly because 'many language features – from pronunciation to vocabulary and grammar – will be acquired naturally if learners have adequate exposure to the language and a motivation to learn' (2006, p. 165). They state that 'classroom activities should be built primarily on creating opportunities for students to express and understand meaningful language' but that 'form-focused instruction and corrective feedback are also essential for learners' continued growth and development. The challenge is to find a balance between meaning-based and form-focused activities.' (Lightbown & Spada, 2006, p. 177) Their examination of other theories such as comprehension-based language learning (which focuses purely on understanding the language rather than on producing the language) or content-based language learning (learning a different subject entirely in the target language) demonstrates that such theories are beneficial for certain areas of language learning but, if used in isolation, are unable to provide students with a comprehensive language learning experience.

Hoppingarner (2009) states that two general themes have emerged in language pedagogy. The first theme is the focus on language as a means of communication rather than an object of study, along with the importance of integrating language skills. Hoppingarner discusses task-based language teaching which plays a major part in this theme. Task-based language teaching 'begins with a real-world task, and builds language-learning activities around it.' (2009, p. 229) This theme generally corroborates Lightbown and Spada's (2006) proposal where tasks are designed to give

students the opportunity to understand and use the target language. However, Hoppingarner does not mention that any aspects of form-focused instruction should be included in task-based teaching. We suggest that to ensure the effectiveness of the tasks it would be vital to allow room for 'form-focused instruction and corrective feedback', as highlighted by Lightbown and Spada. Constructivism is the second theme discussed by Hoppingarner. This theory sees learning as 'an active process by which learners create their own understanding of the subject matter' (Jonassen & Winn, cited in Hoppingarner, 2009, p. 229). Constructivists make a distinction between information and knowledge: 'information is an artifact that is distinct from any individual learner, is quantifiable, and recordable', whereas knowledge is 'part of an individual's cognitive system' (Hoppingarner, 2009, p. 229). Similarly, Boettcher (2007) differentiates between the content of a course and the concepts that need to be acquired. In order to allow students to 'move from concept awareness to concept acquisition' (p. 5), she highlights the importance of making thinking 'visible' (i.e. students should complete tasks that encourage them to create, explain, analyse and judge). Hoppingarner notes how well technology integrates into task-based language teaching and contructivism, because they allow students to use technology as a tool to complete a task or build on the knowledge that they already have.

However, there is also a consensus among the articles that there is still a need to focus some teaching on specific language skills. Lightbown and Spada demonstrate that although a comprehension-based approach to teaching is not wholly successful for language learning, some of the techniques used (e.g. reading comprehension) can be helpful for learning specific language skills. As Boettcher (2007) states in her ninth core learning principle, 'different instruction is required for different learning outcomes' (p. 6). Hoppingarner (2009) also agrees that there is sometimes a need to teach specific language skills as well as integrating all of the language skills into activities. She demonstrates how technology can be used in this situation to aid different reading techniques (e.g. by adding glosses to specific words and structures), or using blogs and wikis to teach the writing process.

6. The Role of Technology in Language Teaching and Learning

From this analysis the following themes emerged:

6.1. Pedagogy over technology

There is a consensus among the articles that pedagogical objectives not technology must lead the way in language teaching and learning. Hoppingarner (2009) states that 'teaching languages with technology must take into account good language pedagogy, and that the introduction of technology neither replaces nor transforms the nature of good teaching.'(p. 232) Salaberry (2002) agrees that the 'most important challenge posed by technology-assisted language learning will be the identification of the pedagogical objective that technology-based teaching is intended to fulfill.' (p. 50) Kern (2006) concludes that 'there is consensus in CALL research that it is not technology per se that affects the learning of language and culture but the particular uses of technology. This emphasis on use highlights the central importance of pedagogy […]' (p. 200). Furthermore, Hoppingarner makes the important point that 'merely including technology in instruction does not guarantee results or learning outcomes' (p. 223).

6.2 Treat unsubstantiated claims and expectations about educational technology with caution

The articles in this review can also be seen in the light of the wider discussion of the role of technology in society. The authors are neither strong advocates of technological determinism – 'the idea that technology develops as the sole result of an internal dynamic and then, unmediated by any other influence, molds society to fit its patterns' (Winner, 1986, p. 1) – nor wholly proponents of social determinism ('what matters is not technology itself, but the social or economic system in which it is

embedded' (Winner, 1986, p. 1)). They are trying to strike a balance between the two ideas. It is clear from point A above that the underlying pedagogical system should shape the use of the technology, but this does not exclude the possibility that technology can shape teaching in some way. Boettcher's third principle, 'we shape our tools and our tools shape us,' encapsulates this idea. Finding a balance between these extreme views also justifies the caution articulated in the articles about the use of technology for language learning. Salaberry, for example, states that we need a 'healthy dose of scepticism' in contrast to the 'perhaps overly enthusiastic reaction to previous technological breakthroughs' (2002, p. 52). In addition, Hoppingarner interprets previous attitudes to technology and language learning as 'a warning against over-enthusiastic expectations of educational technology' (2009, p. 222).

6.3 The learner is central to the teaching and learning process

Boettcher's first principle reminds us that: 'every structured learning experience has four elements with the learner at the center'. Two further principles deal with the importance of the learner: the need for teachers to be aware of the knowledge, skills and attitudes of their students and the need to assess students' understanding on a regular basis (2007, pp. 1-5). Hoppingarner also emphasises the danger of assuming students have learned and understood underlying concepts because they can complete exercises correctly, which is particularly pertinent with regard to some forms of computer-based instruction. Furthermore, Salaberry notes that 'research has been excessively focused on the technical capabilities of the tools' (2002, p. 51) rather than on pedagogy or the learner.

6.4 Technology should be dynamic, interactive and present information in chunks

Boettcher states that 'the more dynamic and interactive the learning experience, the more likely students will invest greater amounts of time in the learning process'. She suggests that virtual media environments, simulations and animations are useful because they enable information to be presented in chunks which makes learning more efficient (2007, pp. 6-7). Games and role-playing scenarios are also valuable because of their 'unpredictability, interactive qualities and infinite variety' (2007, pp. 6-7). Hoppingarner also states that although programmed instruction is generally not successful, computer-based work can increase interaction and student engagement.

6.5 Importance of integrating technology fully into the classroom while not simply repeating what has been done in the past

Hoppingarner states that technology 'should be part of the basic infrastructure of teaching not just an add-on,' (2009, p. 233) while Kern also highlights the importance of integrating technology into language learning: 'the success of CALL integration will be marked by the disappearance of the term CALL' (Bax, cited in Kern, 2006, p. 185). Salaberry agrees with the importance of integrating technology but also recognises the dangers of simply assimilating new technology into existing practices which 'reflects a failure to seize new opportunities' (2002, p. 50). The articles demonstrate the divide between views of technology as a tool that allows us to do something we already do more efficiently and seeing technology as something which offers new possibilities. However, none of the articles suggest any practical ways to create this basic infrastructure for technology in language teaching and learning. Perhaps this is too complex a problem for language teachers alone to deal with; however, we propose that grounding the use of technology in language pedagogy will go some way to dealing with this issue.

6.6 Teacher is more important than technology

The move away from instruction-based teaching to a more constructivist, student-centred style of teaching has changed a teacher's role from the simple transfer of information to that of a guide or a facilitator. However, this by no means diminishes the role of the teacher in the learning experience. Salaberry highlights that one of the many important roles of the teacher is to 'delineate clearly specific pedagogical objectives in order to select the appropriate tool' (2002, p. 51). Moreover, Boettcher may emphasise the central position of the learner but her fourth principle states that 'faculty are the directors of the learning experience' (2007, p. 3). Thus, despite their changed role, teachers have the ultimate control over how, what and where students are taught.

6.7 Evaluative Framework

This review of relevant articles has provided some important background information for the evaluation of augmented reality applications for language teaching and learning. Building on this we now propose a framework for the evaluation of existing AR resources used for language learning, as well as for those resources which could be adapted for this purpose. The framework aims to be of use to those employing such technologies, as well as those developing or repurposing them. Naturally, it can form one part of the picture only– it is also vital to involve learners in the process along with other qualitative methodologies such as user testing. To the best of our knowledge no other framework exists for the use of augmented reality in language learning. The criteria for evaluating technology for language teaching and learning are outlined in the following table.

Table 1: *Evaluative Framework*

	The software should:
1	Have clearly stated pedagogical objectives.
2	Focus on specific language skills
3	Enable the integration of different language skills.
4	Allow for task-based, exploratory language learning
5	Enable learners to build on existing knowledge and develop this knowledge further.
6	Provide some form-focused instruction and corrective feedback
7	Create opportunities for communicative, meaning-based interaction in the target language.
8	Situate the learner at the centre of the learning process.
9	Provide a dynamic, interactive learning experience.
10	Be integrated into the learning process.
11	Add value (i.e. something that cannot be done as effectively without technology) to language teaching and learning.
12	Encourage motivation.
13	Maximise exposure to the language.

It is unlikely that any application can fulfil all of these criteria: for example, it would be difficult to focus on specific language skills and integrate different language skills at the same time. However, the application should fulfil a majority of the criteria and, most importantly, the design should be driven by pedagogical-technological considerations and not simply driven by technology.

7. Augmented Reality Applications: Case Studies

Our survey of the landscape uncovered a number of software tools that are suitable for language teaching and learning. They include Put a Spell, SSAT AR quizzes, Campus Life, Mentira, a Context-Sensitive Microlearning of Foreign Language Vocabulary research project and SmashCards. Two further augmented reality applications also have the potential to be repurposed for AR-driven language teaching and learning: ZooBurst and Second Sight. Given the rapidly changing technological ecosystem we provide case studies of three of these in order to demonstrate the viability of the framework rather than attempting to give a comprehensive survey of the augmented reality applications that exist for the sector.

7.1 Specialist Schools and Academies Trust (SSAT) AR Quizzes

SSAT has created LearnAR, a set of augmented reality curriculum resources, and describes augmented reality as 'a cutting edge tool bringing learning to life' (Specialist Schools and Academies Trust [SSAT], 2009). The language resources take the form of quizzes; questions are answered by holding different coloured markers up to a webcam. The resources can be used for independent learning on laptops, and desktops or they can be used for group learning on an interactive whiteboard (SSAT, 2009).

The LearnAR resources are easy to implement: all that is needed is access to a webcam and the internet. We attempted to run the resources on a new laptop (Dell N5030, Intel Celeron CPU 925 @ 2.30GHz, 2GB RAM) but found that it was not powerful enough to run the quizzes – this brings the accessibility of the resources into question, particularly as the power of machines can vary greatly from school to school. The quiz enables the learner to see the word on the screen and hear the correct pronunciation of it, thus targeting vocabulary acquisition and listening skills. However, there is very little opportunity for meaningful interaction in the game and even the focus on specific language skills is limited. A small improvement to the game would be to use the target language for marking the players' efforts (correct and incorrect are currently written and spoken in English) and perhaps adding an extra task to construct a sentence with the correct word. However, it is not clear how the quizzes (at present available for French and Spanish) advance the varied, non-AR quizzes that can be found on the internet. It seems that more thought has been given to bringing 'a wow-factor to the curriculum' (SSAT, 2009) than to the innovations that AR might bring to the classroom and to the pedagogical objectives of the task.

Table 2: *SSAT AR Quizzes*

Framework Criteria (see Table 1)	Does the application fulfil the criterion?
1	No
2	Yes
3	No
4	No
5	No
6	No
7	No
8	No
9	Yes – interactive but not very dynamic.
10	No
11	No
12	No
13	No

7.2 *Example of extensible: ZooBurst*

ZooBurst is a 'digital storytelling tool that lets anyone easily create his or her own 3D pop-up books. … As an educational tool, ZooBurst gives students new ways to tell stories, deliver presentations, write reports and express complex ideas' (ZooBurst, n.d.)

Although ZooBurst has not been specifically designed for language teaching and learning, it is a flexible tool that it could be used for this purpose. Moreover, the online gallery of ZooBurst books demonstrates that it has been used for simple stories in different languages. The books are completely customisable: images can be taken from the ZooBurst image bank or users can upload their own images and even create audio recordings to add to the story. Furthermore, ZooBurst contains a 'classroom management' feature that lets teachers 'easily set up protected, safe spaces for their students' (ZooBurst, n.d.). It is important to note that ZooBurst is the only application in this overview which explicitly deals with the issue of online safety. The books can be used with or without the augmented reality setting. The AR mode, which uses a special marker and a webcam, makes the book 'fly out' at the user and allows it to be gesture controlled. At its most basic level, ZooBurst requires 'nothing more than a web browser running the Adobe Flash plug-in,' (ZooBurst, n.d.) but to make use of the augmented reality mode a webcam is also needed. This technology is already widely available in schools.

In order to experience mobile ZooBurst, books can be downloaded on to a smartphone and tracking markers are used to 'tie' the book to the real world. The mobile application will allow access to the books anytime and anywhere and, if used for language teaching and learning, could greatly increase exposure to the target language. However, it is questionable how many primary school children would have access to a smartphone in order to take advantage of the application.

ZooBurst is a promising application for language teaching and learning[ii]. It enables the integration of all of the language skills because pupils do not simply have to read and listen to the story but can create the stories themselves. It also allows pupils to build on the skills they already have in an interactive, meaningful way.

The area where ZooBurst can be found lacking is in the absence of form-focused instruction and corrective feedback. This is perhaps because it has not been designed specifically for language teaching and learning. Thus, wholly effective use of this application is dependent on the teacher, first, to allow the pupils the freedom to create the books themselves and second, to incorporate some form-focused instruction into the activities.

Table 3*: ZooBurst*

Framework Criteria (see Table 1)	**Does the application fulfil the criterion?**
1	Yes
2	No
3	Yes
4	Yes
5	Yes
6	No
7	Yes
8	Yes
9	Yes
10	Yes (but dependent on teacher)
11	Yes
12	Unclear
13	Yes

7.3 Augmented Reality Applications for Secondary Schools

Place-Based Augmented Reality Games for Language Learning: Place-based AR games are collaborative and exploratory in their nature and encourage pupils to build up their knowledge from life-like situations. There are high hopes for place-based augmented reality games which can provide context-aware environments for learning. These games have dealt mainly with social studies and scientific topics and there are very few which have been designed specifically for language learning. However, two games designed for this purpose were identified: Campus Life, a game designed for Taiwanese, Japanese and Korean EFL students and Mentira, a game for learning Spanish in the south-west United States.

7.3.1 Mentira

Mentira was designed for college students studying in Albuquerque, which has a significant Spanish-speaking neighbourhood in which the game could be situated. The game was played on an iPod Touch, a widely available mobile device. Mentira was designed to fit in with the college curriculum and included sections to be played in the classroom and sections for on-location game-play. The game was played over a period of four weeks, with one hour a week of class time dedicated to the game. It also replaced one of the assessed oral presentations in the course; evidently integrating the game into the course was taken seriously. The narrative was a key element in the game because previous research had found this factor to be vitally important for engaging students in the gaming and learning process. The students' task was to solve a prohibition-era murder in small groups in order to absolve their family name.

The tasks had to be carried out in the target language in order to progress through the game. Holden and Sykes (n.d.) argue that 'place' is vitally important in language learning, however, this is often not reflected in formal education environments: 'in the foreign language classroom, place is an especially abstract concept where language is often isolated from the communities, cultures, and places in which it is spoken' (Kramsch & Thorne, cited in Holden & Sykes, n.d., p. 5). The research paper did not provide any empirical evidence of changes in the levels of pupil attainment as a result of the experience and the group was not compared to a control group, as in the Campus Life research. But the students reported that they were more motivated during the on-location sections of the game than in the classroom-based activities. This could be due to the novelty factor of being outside the classroom. However, it was found that their engagement with the subject area continued long after the game was completed. The Mentira research made the important point of incorporating the game into the Spanish lessons and the curriculum, noting that 'to be transformative, innovations, especially technologically-enabled ones, must seek to become a part of the classroom experience, as opposed to a disconnected add-on' (Holden & Sykes, n.d., p. 9). The importance of integrating technology into the language learning experience is a significant part of the evaluative framework used in this study and the Mentira game has dealt with this explicitly and, it seems, successfully. However, the Mentira creators were fortunate in that they had a Spanish neighbourhood in close proximity to the college.

Table 4: *Mentira*

Framework Criteria (see Table 1)	Does the application fulfil the criterion?
1	Yes
2	No
3	Yes
4	Yes
5	Yes
6	No
7	Yes
8	Yes
9	Yes
10	Yes
11	Yes
12	Yes
13	Yes

7.3.2 Context-Sensitive Microlearning of Foreign Language Vocabulary

The research by Beaudin et al. (2007) into a context-sensitive microlearning environment for foreign language vocabulary is an example of how technology can be deployed to integrate language learning with everyday surroundings. 'Built-in and stick-on sensors detected participants' interactions with objects, furniture, and appliances in the home; this triggered the audio presentation of English and Spanish phrases associated with the use of those objects.' (Kukulska-Hulme, 2009, p. 163) The creators of this prototype believe that 'automatic detection of context may enable learning tools that present information and interactions to people at appropriate moments as they engage in their everyday lives.' (Beaudin et al., 2007, p. 55) The concept is based on an 'eLearning technique called "microlearning," where a difficult learning task is broken into a series of very quick learning interactions, distributed over time.' (Beaudin et al., 2007, p. 56) 'Chunking' is also one of the methods for effective language teaching and learning highlighted in the critical review. The prototype is clearly designed to increase vocabulary acquisition but it also integrates listening skills. The application aims to maximise exposure to the language and integrate it in everyday situations. It therefore addresses a number of the criteria laid out in the evaluative framework. Furthermore, the experience did have a positive effect on the participants' language acquisition: 'both participants performed better on audio comprehension of phrases that were presented during the study than on those they had not heard during the study.' (Beaudin et al., 2007, p. 63)

However, this application does have a number of limitations, some which are acknowledged by the researchers and other limitations which I foresee in relation to implementing applications of this kind in the classroom. Beaudin et al. (2007) point out some of the limitations of this prototype: 'the brief interactions used by microlearning systems may not be appropriate for in depth learning, but they may allow users to chip away at a larger learning goal.' (p. 56) The participants found that the exercise would have been more beneficial if they had always been able to see the words as well as hear them – this highlights the importance of stimulating more than one sense when acquiring new knowledge. The participants suggested that it would also be useful to have a way of reviewing the vocabulary that they heard throughout the day and it would have been more interesting if 'the vocabulary set had gradually shifted to include verbs and phrases' (Beaudin et al., 2007, p. 67). The possibility of more interactive features, such as an optional quiz, would also be appealing as it would force the participants to listen more closely to the phrases rather than simply having this passive exposure to the language (Beaudin et al., 2007, p. 68).

It should be noted that this application was designed to be used in a home environment and not in schools. As a result, there are a number of challenges to overcome if it were to be used in the

classroom. The pilot was carried out in a specially designed house, which was covered in sensors to trigger the audio recordings. It would be very time consuming to recreate this in a classroom. The use of object recognition on a handheld device and GPS tracking could be used instead but this would not be triggered by movement but by the conscious use of a handheld device on a physical object. Moreover, the constant tripping of audio recordings via movement sensors would be disruptive in the classroom. This application would need dramatic rethinking for use in the classroom but it demonstrates the benefits of being able to annotate your environment with audio-visuals to increase exposure to a foreign language (this could also involve a variety of language skills, for learners do not simply have to look and listen to the annotations but can also create some themselves using, for example, location-based micro-blogging applications, such as Brightkite). It also proves how well suited mobile devices are to augmented reality applications which help to embed language learning in everyday life since 'they are both pervasive and ubiquitous, both conspicuous and unobtrusive, both noteworthy and taken for granted in the lives of most of the people in this country' (Traxler, 2008, p. 3). Moreover, they are particularly well used by young people – research even shows that more young people own a mobile phone than a book (The Literacy Trust, 2010). They allow access to resources any time, anywhere and could support informal learning and promote autonomous learning. As ever, it would be vital for the activities and applications to have clear pedagogical objectives.

Table 5: *Context-Sensitive Microlearning of Foreign Language Vocabulary*

Framework Criteria (see Table 1)	Does the application fulfil the criterion?
1	Yes
2	Yes
3	No
4	No
5	No
6	No
7	No
8	Yes
9	No
10	Unclear – for a school environment
11	Yes
12	Unclear
13	Yes

Integrating mobile devices into a school environment is fraught with problems. The school has to decide whether to provide pupils with devices or allow pupils to use their own devices. There is not a simple solution to either option. With regard to institutional mobile devices, this is not only an extra expense for schools but as Traxler (2008) demonstrates, early pilots suggest that 'university students were not likely to value a second device, a university-provided device that did not express their taste or aspirations.' (p. 14) It is questionable how school-age children would react. On the other hand, allowing pupils to use their own mobile devices would be just as problematic. Extensive acceptable use policies would have to be created, applications which are compatible with many operating systems would have to be provided and support and training on different kinds of devices would have to be given to teachers (Traxler, 2008, pp. 14-16). Equality of access to mobile devices would also be problematic if pupils were to use their own devices. Moreover, there would be issues of security and privacy, particularly as a result of the use of geo-located AR applications. It is clear that the world of technology is becoming increasingly mobile and the proliferation of mobile AR apps indicates that augmented reality will continue to move in this direction. Thus, it is necessary for schools to keep up with these advances where it adds value to learning. However, as outlined above, there are still many

problems to overcome in order to integrate mobile activity safely and effectively into a language learning environment.

8. Conclusion

The aim of the framework was to provide a more learner-centred approach to the analysis, evaluation and implementation of AR technology for language teaching and learning in the classroom.

The case studies of AR applications for language teaching and learning have demonstrated that the applications with the most potential for language teaching and learning are those which state their pedagogical aims explicitly: ZooBurst (although the pedagogical aims do not address language teaching and learning), Campus Life, Mentira and SmashCards. A further application, the Context-Aware Vocabulary project, shows some promise (fulfilling 5 out of 13 of the criteria) but it is still questionable how suitable it would be for a school environment. The remaining three applications (Second Sight, SSAT Quizzes and Put a Spell) are rather limited in their scope and ability to aid language teaching and learning in schools, partly because they do not have clear pedagogical objectives but also because they do not fully exploit augmented reality. Instead, they replicate existing educational practices and AR is used as no more than an add-on for novelty value. In such cases there seems little point for schools to invest in this use of the technology.

The evaluative framework created in this study has established a potentially useful baseline for making decisions about the possible use of augmented reality applications for teaching and learning in the classroom. However, the evaluation of augmented reality applications and the discussion of wider implications have highlighted some limitations of the framework used. Further research could be carried out into how a wider range pedagogical theories and applications could provide a more comprehensive framework for assessment of software.

One issue that still needs to be addressed is the need to continuously assess and promote information literacy and technical skills as well as language skills. Although pedagogy must take precedence over technology, the current criteria overlook the technical abilities of students and neglect the technical implications of some of the applications. Thus, while this study has made a positive start with establishing a framework for evaluating augmented reality applications for language teaching and learning on the basis of what they actually do, and not what it is claimed they can do, there is still more work to be done in this area.

References

American Association of School Librarians. (2011). Best Websites for Teaching and Learning. Retrieved from: http://www.ala.org/ala/mgrps/divs/aasl/guidelinesandstandards/bestlist/bestwebsitestop25.cfm (Accessed 04/05/2012)

Anon. (2002). Archeoguide. Retrieved from: http://archeoguide.intranet.gr/ (Accessed 04/05/2012)

Anon. ZooBurst. (n.d.). Retrieved from: http://www.zooburst.com/index.php (Accessed 04/05/2012)

Azuma, R.T. (1997). A Survey of Augmented Reality, *Presence: Teleoperators and Virtual Environments*, 6/4, 355-385. Retrieved from: http://www.cs.unc.edu/~azuma/ARpresence.pdf (Accessed 04/05/2012)

BBC News. (2011). Augmented reality looks set to become a serious commercial tool. Retrieved from: http://www.bbc.co.uk/news/business-13262409 (Accessed 04/05/2012)

Beaudin, J.S., et al. (2007). Context-Sensitive Microlearning of Foreign Language Vocabulary on a Mobile Device. *Lecture Notes in Computer Science, 4794*, 55-72. doi: 10.1007/978-3-540-76652-0_4

Boettcher, J.V. (2007). Ten Core Principles for Designing Effective Learning Environments: Insights from Brain Research and Pedagogical Theory. *Innovate, 3/3*. Retrieved from: http://innovateonline.info/pdf/vol3_issue3/Ten_Core_Principles_for_Designing_Effective_Learning_Environments-__Insights_from_Brain_Research_and_Pedagogical_Theory.pdf (Accessed 04/05/2012)

Carpenter, T. (2010, February 23). 7 Ways Augmented Reality Will Change Your Brain [Web log message]. Retrieved from: http://thomaskcarpenter.com/2010/02/23/7-ways-augmented-reality-will-change-your-brain/ (Accessed 04/05/2012)

Fenn, J., & LeHong, H. (2011). *Hype Cycle for Emerging Technologies 2011*. Retrieved from: http://www.gartner.com/DisplayDocument?id=1754719&ref=%27g_fromdoc%27#h1 (Accessed 04/05/2012)

Fletcher, D. (2010, March). 10 Tech Trends for 2010, *Time*. Retrieved from: http://www.time.com/time/specials/packages/article/0,28804,1973759_1973760_1973797,00.html (Accessed 04/05/2012)

Futurelab. (2010, July-December). Augmented reality in education: taking a different view of learning. *Vision Magazine*, 11. Retrieved from: http://archive.futurelab.org.uk/resources/documents/vision/VISION_11.pdf (Accessed 04/05/2012)

Holden, C.L., & Sykes, J.M. (n.d.). *Leveraging Mobile Games for Place-based Language Learning*. http://arisgames.org/wp-content/uploads/2011/04/Holden_Sykes_PROOF.pdf (Accessed 04/05/2012)

Hoppingarner, D. (2009). Best Practices in Technology and Language Teaching. *Language and Linguistics Compass, 3/1*, 222-235. doi: http://dx.doi.org/10.1111/j.1749-818X.2008.00123.x (Accessed 04/05/2012)

Jenkins, H. (2008). An Interview with Eric Klopfer (Part One). Retrieved from: http://henryjenkins.org/2008/07/an_interview_with_eric_klopfer.html (Accessed 04/05/2012)

Johnson, L. et al. (2011). *The Horizon Report: 2011 Edition*. Retrieved from: http://www.nmc.org/pdf/2011-Horizon-Report.pdf (Accessed 04/05/2012)

Kern, R. (2006). Perspectives on Technology in Teaching and Learning Languages. *TESOL Quarterly, 40/1*, 183-210. Retrieved from: http://www.jstor.org/stable/40264516 (Accessed 04/05/2012)

Kukulska-Hulme, A. (2009). Will mobile learning change language learning? *ReCALL, 21/2*, 157-165. Retrieved from: http://oro.open.ac.uk/16987/1/download.pdf (Accessed 04/05/2012)

Lightbown, P., & Spada, N. (2006). *How languages are learned*. Oxford: Oxford University Press.

The Literacy Trust. (2010). New research reveals more young people own a mobile phone than a book. Retrieved from: http://www.literacytrust.org.uk/campaigns-policy/media/2042_new_research_reveals_more_young_people_own_a_mobile_phone_than_a_book (Accessed 04/05/2012)

Livingstone, M.R. et al. (2002). An Augmented Reality System for Military Operations in Urban Terrain, *Proceedings of Interservice / Industry Training, Simulation & Education Conference (I/ITSEC)*. Retrieved from: http://ntsa.metapress.com/link.asp?id=qdntl0771u631dam (Accessed 04/05/2012)

Mahoney, Michael S. (2005). The histories of computing(s). *Interdisciplinary Science Reviews*, 30/2, 119-135.

Milgram, P. et al. (1994). Augmented Reality: A Class of Displays on the Reality-Virtuality Continuum, *SPIE: Telemanipulator and Telepresence Technologies,* 2351, 282-292. doi: 10.1.1.83.6861

Natural History Museum. (2011). Interactive film – who do you think you really are? Retrieved from: http://www.nhm.ac.uk/visit-us/darwin-centre-visitors/attenborough-studio/interactive-film/index.html (Accessed 04/05/2012)

Salaberry, M.R. (2002). The Use of Technology for Second Language Learning and Teaching: A Retrospective. *The Modern Language Journal, 85/1*, 9-56. doi: 10.1111/0026-7902.00096

Shute, T. (2009). Augmented Reality – Bigger than the Web: Second Interview with Robert Rice from Neogence Enterprises. http://www.ugotrade.com/2009/08/03/augmented-reality-bigger-than-the-web-second-interview-with-robert-rice-from-neogence-enterprises/ (Accessed 04/05/2012)

Specialist Schools and Academies Trust. (2009). Augmented Reality. Retrieved from: https://www.ssatrust.org.uk/achievement/future/Pages/AugmentedReality.aspx (Accessed 04/05/2012)

Sterling, B. (2009, September). Augmented Reality: The Ultimate Display by Ivan Sutherland, 1965. *Wired*. Retrieved from: http://www.wired.com/beyond_the_beyond/2009/09/augmented-reality-the-ultimate-display-by-ivan-sutherland-1965/ (Accessed 04/05/2012)

Traxler, J. (2008). *Learners – Should We Leave Them To Their Own Devices?* Retrieved from: http://webarchive.nationalarchives.gov.uk/20101102103713/http://emergingtechnologies.becta.org.uk/upload-dir/downloads/page_documents/research/emerging_technologies/learners_johntraxler.pdf (Accessed 04/05/2012)

Winner, L. (1986). *The whale and the reactor: A search for limits in an age of high technology*. Retrieved from: http://zaphod.mindlab.umd.edu/docSeminar/pdfs/Winner.pdf (Accessed 04/05/2012)

[i] The film has won the British Universities Film and Video Council (BUFVC) for Learning on Screen Premier Award (multimedia) 2011: Natural History Museum. (2011). Interactive film – who do you think you really are? Retrieved from: http://www.nhm.ac.uk/visit-us/darwin-centre-visitors/attenborough-studio/interactive-film/index.html

[ii] ZooBurst was recently named as one of this year's 'Top 25 Websites for Teaching and Learning' by the American Association of School Librarians (AASL). The criteria for inclusion on this list are websites which 'foster the qualities of innovation, creativity, active participation, and collaboration': American Association of School Librarians. (2011). Best Websites for Teaching and Learning. Retrieved from: http://www.ala.org/ala/mgrps/divs/aasl/guidelinesandstandards/bestlist/bestwebsitestop25.cfm