Enhancing Virtual Learning Environments with Generic Games Supporting Assessment *for* Learning

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Abstract— Virtual Learning Environments (VLEs) offer huge potential in Further and Higher education. However, at Primary school level, the use of such environments is quite limited. Northern Irelands' primary schools have access to a VLE namely *LearningNI*. However its adoption and potential may need to be readdressed. This paper presents an enhanced learning environment called AmbiLearn, focusing on a generic game module, specifically designed for primary school children to aid in the constant assessment for learning activities that happen in daily classroom learning. An experimental design for testing AmbiLearn has been designed and is currently in-progress to assess its educational potential.

Keywords- AmbiLearn, Virtual Learning Environment, serious games, Generic game module Assessment For Learning.

I. INTRODUCTION

Education in the UK follows a minimum standard of educational guidance provided by the National Curriculum. Having been reformed significantly since its first mainstream introduction in 1998, the national curriculum in Northern Ireland provides guidance on cross curricular learning or connected learning through Six main Areas of Learning [1] defined as Language and Literacy, Mathematics and Numeracy, The Arts, The World around us, Personal development & Mutual understanding and Physical Education [2][3]. Certain policies and practices have significantly influenced this curriculum such as the *Rose Review* [4] resulting in the use of phonics for early reading, *The empowering Schools* Strategy [5] and *Harnessing Technology* Initiatives [6] which incorporated the use of a technological infrastructure in the schools. Classroom 2000 (C2K) was established as a government initiative to provide ICT services and infrastructure across Northern Ireland [7]. One service the C2K provide is a virtual learning environment (VLE) called *LearningNI*. However, its adoption amongst primary schools is limited. In an inspection report conducted in 2010 [8], the Education Inspectorate noted that the use of *LearningNI* was 'disappointingly low' with fewer than 4% of primary schools accessing the platform during February of that year.

Due to a constant reform of the education system in Northern Ireland and a renewed importance on 'Assessment For learning', this research aims to redress this limited use of VLEs in primary education by adapting the VLE to be more appropriate and suitable for the intended target group of primary school children. AmbiLearn is proposed as an enhanced VLE with a reusable game module and plug-in pedagogical model. Designed as a content neutral game enables AmbiLearn applications to be adapted to any area of learning appropriate for each user. AmbiLearn is currently being evaluated within primary schools in Northern Ireland as a field study is in progress. This paper outlines work involving the design and implementation of AmbiLearn and preliminary evaluation results.

A. Research Objectives

The objectives of this research are to:

- Investigate means of redressing the limited use of VLEs in primary school education.
- Address such issues in the implementation of AmbiLearn, an enhanced learning environment in primary school education.
- Demonstrate and test the educational potential of AmbiLearn in primary school education.

II. BACKGROUND RESEARCH

A. Virtual Learning Environments

A Virtual Learning Environment (VLE) is essentially an educational tool which helps dispense course material and monitor a students' progress online. The use of such VLEs in higher education has had a positive effect for distance learners [9][10]. Such assessment tools have shown to improve student learning [11][12] and the communication tools have the potential to support collaborative learning and peer learning [13][14]. The nature of higher education provides students time between lessons to further read-up on material provided through the VLE. At lower levels of education this time is reduced significantly. In the primary school using the VLE as a method to administer course material is unsuitable as in an average primary school day (5 hours) many different topics will be covered. It was suggested by *Ofsted* [15] that the limited use of VLEs in primary schools is due to the lack of material available in relation to the topics covered. The presentation style of content available from most VLE's is

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static downloadable content with limited interactivity which does not suit an age where children already experience a range of multimodal interfaces in their everyday lives. With Interactive white boards (IWBs) infrastructure in place in nearly all primary school classrooms, pedagogical content has become interactive. Case studies [16][17][18] have shown that the use of IWBs for full class teaching has had a significant effect on pupil participation and motivation. The effects of such technology on actual attainment is unclear [19][20] but plays a major role in engaging and motivating children in their learning interactivity.

B. *Serious Games*

Using computer games in education is not a new concept. However this area has gained much attention due to the increased variety of gaming platforms. In higher education institutes this is reflected by educational research in virtual worlds and simulation type learning [21]. In children's educational research the investigation of virtual worlds for literacy is growing [22]. However it is questioned whether the educational potential of such environments could possibly have a shadow cast upon them due to child protection and multiple ethical considerations of online worlds for children at a primary school level. Educational software classed as computer games has provided children with a fun, playful approach to learning. As [23] suggests, such games can facilitate learning through tasks populated by educational content, knowledge developed through the content and skills arising as a result of the game structure. However, many commercial off-the-shelf products provide educational content specific to one domain or subject such as Mathematics or Spelling. Overcoming this, some software provides opportunities for the educator themselves to determine content, e.g. *BlackCat Activity Builder* [24] is one such suite of tools which enables a teacher to input English sentences for a grammar exercise or facts for science worksheets. One limitation of such tools is the use of recording user interaction. As a standalone piece of software these games do not provide user logging.

C. *Assessment for Learning*

Standardized tests in NI primary schools are currently undergoing changes as new contracts have been established to provide computer based assessments for each year of Key Stage 2 [25]. One finding which brought such changes was that of the lack of confidence in the reliability of a one-off assessment of measuring attainment [26][27]. In light of this emphasis has been placed on the idea of assessment *for* learning which is described as the informal assessment that occurs in the classroom everyday through observation, oral work, written work and end of unit testing [28]. This assessment is based on summative judgments made by the classroom teacher which results in the teacher making necessary instructional adjustments to ensure understanding and learning of the presented material or concept [29].

III. AMBILEARN

Investigating how to redress the limited use of virtual learning environments in primary school education has prompted the development of AmbiLearn, a multimodal learning environment for children. AmbiLearn can be viewed as an enhanced VLE with a reusable game module and plug in pedagogical model. The layered architecture of AmbiLearn is shown in Fig. 1. Enhancing the VLE, AmbiLearn includes a game module. This is defined as a reusable game framework as it is content neutral which facilitates the adoption of the game to multiple themes as defined by a plug-in pedagogical model created through AmbiLearn's content creation module. In addition, all game activities are logged and used to report to the teacher the whole class game scores.

A popular virtual learning environment namely *Moodle* (Modular Object Oriented Dynamic Learning Environment) was used in the implementation of AmbiLearn as it provides the necessary support and has the advantage of being open source. A comparison of *Moodle* and *LearningNI* shows that both environments exhibit the same main functionality of typical VLEs.

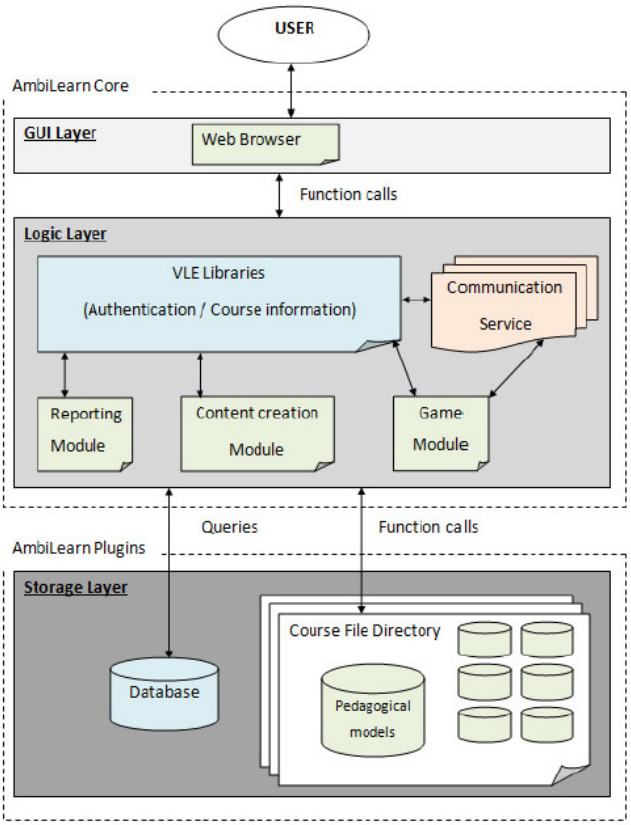

Figure 1. AmbiLearn Layered Architecture

A. *Game Module*

The game module is designed with activities that are adapted from popular worksheets used within primary schools and are implemented into the environment as content neutral enabling a reusable component. The game itself consists of a map where the user accesses five different activities illustrated in Fig. 2. These activities include:

- AmbiGuess (A-G): A 'What am I' style game, where a player is given clues and must select the object associated with the clues.
- Wordsearch (W-S): A letter grid consisting of hidden relevant key words for the given theme, where the player must find and highlight the words provided by a word list.
- FactMatch (F-M): A matching game where two facts must be paired by the user, hence removing both facts from the game.
- AmbiJig (F-M): An image which is split into pieces and scrambled. The player must recreate the image like a jigsaw, where the pieces will attach together upon correct positioning.
- AmbiQuiz (A-Q): A multiple choice quiz with questions and answers.

Figure 2 AmbiLearn Main Map Scene

Scores and times from each activity are recorded and provided to the user as feedback. A little character 'Ambi' is stranded on `TreasureLearn Island' and the child/user must complete these activities to help him retrieve pieces of his boat. On completion of each activity a 'boat piece' is allocated therefore once all 'boat pieces' are collected the user can save 'Ambi'. The game module is implemented in Action Script (AS) 3 using Flash Professional Creative Suite 5. Fig. 3. Provides an overview of the game play 'logic'.

B. *Content Creation Module*

Many games developed in educational setting employ static content. These are mainly commercial off-the-shelf games and once completed the novelty and attraction is usually gone. AmbiLearn overcomes this limitation as the game module is designed to be reusable and hence content neutral. The game content i.e. the pedagogical knowledge, is a plug-in module. This module is implemented as an XML file which enables the data structure and nodes to be designed corresponding to game activities. As teachers are the creators of such pedagogical models, an intuitive interface was designed to enable creation of XML models through web forms. The educator thus follows a series of forms to add the associated activity data and upon completion he/she may test the game before saving the XML model to his/her associated course directory.

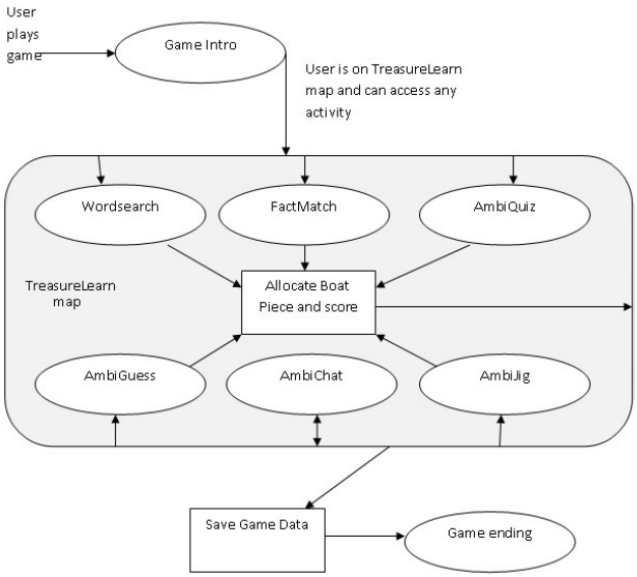

Figure 3 AmbiLearn 'game play' logic

In the AmbiLearn environment a *Moodle* Plug-In [30] was incorporated to enable linkage between a SWF file and associated XML file. Therefore, the generic game module needs only to read in the associated flash variables of its instance, to identify which pedagogical model to process in order to gain the activities content.

C. *Reporting Module*

As the game module provides five activities, a report is generated for each in addition to a full game report. Hence, each game instance will produce six class reports as documented in Table I.

TABLE I. REPORTING MODULE OUTPUT

Report	*Data Reporting*	*Report Format*
Overall game score	Full score for each user broken down by activity	Stacked Chart
AmbiGuess Report	Individual activity score as a % for each user	Bar chart (ASL)
	Number of incorrect guessed objects for each user who scored <100%	Bar chart
	Incorrect objects guessed by user	Table
Wordsearch Report	Individual activity game time for each user	Bar chart (ASL)
FactMatch Report	Individual activity score as a % for each user	Bar chart (ASL)
	Number of incorrect guessed matches for each user who scored <100%	Bar chart
	Incorrect matches guessed by user	Table
AmbiJig	Individual activity game time for each user	Bar chart (ASL)
AmbiQuiz Report	Individual activity score as a % for each user	Bar chart (ASL)
	Number of incorrect answers for each user who scored <100%	Bar chart
	Incorrect answers given by user	Table

* (ASL) denotes an average score line

IV. EVALUATION RESULTS

A field study for testing AmbiLearn is designed to include children from Primary Schools at Key stage 2 levels and their class teacher. All user subjects are added to AmbiLearn by the researcher with unique codes so that no identifiable names are recorded. Before any experiment is conducted all subjects are provided with information on the study which explained what they would be required to do. The child participants are provided with an information sheet which also contained consent forms which required additional parental signature as well as the child's. All children who took part in the study had obtained consent from their parents/guardians. The study is designed in three stages: First the researcher spent time with the class teacher to create the pedagogical model. The teacher was provided with information outlining the game and was asked to adapt an appropriate unit of learning to fit the game framework. This stage resulted in an application of AmbiLearn, called TreasureLearn, available to the class who participated in the second part of the study. The child participants, as a whole class (in their school computer suite) logged on to AmbiLearn and played TreasureLearn. The third part of the study was completed with the class teacher in reporting back class scores from the TreasureLearn application. One full class is deemed as a trial and at present one trial has been completed.

A. Preliminary Results

At each stage of the study an evaluation booklet was provided to both the class teacher and child participants. Trial one has provided preliminary results from a population of 23 child participants and 1 class teacher. Hence, only the child's responses are analysed at this stage. From this sample population 20 responses were deemed valid resulting in 8 male respondents (7 aged 11; 1 aged 12) and 12 female (aged 11). The data provides the evaluation of the game module in the TreasureLearn activity, i.e. the actual game play. Overall 100% of the sample enjoyed playing the TreasureLearn game. Fig. 4. shows responses obtained (through a five point Likert scale ranging from '(1) not at all', '(2) not really', '(3) not sure', '(4) yes' and '(5) yes, definitely') when asked:

- (ALschool) Would you like to play AmbiLearn in school again?
- (ALhome) Would you like to play AmbiLearn at home?
- (Learn) Do you think this game helped you remember what you learnt in school?
- (AllLearn) Would you like this game as a revision guide for all the topics you learn in school?

These results indicate that the child respondents perceive that AmbiLearn can be a tool to support their learning and revision and would like to use such a tool in school and/or at home. To explore the activities within the game, each child was asked questions to measure four factors for each activity. The responses were obtained through a five point Likert scale ranging from '(1) not at all', '(2) not really', '(3) not sure', '(4) yes, a bit' and '(5) yes, definitely'. Table 2 shows the means from each of the following questions:

- (FUN) Did you think this activity was fun?
- (ENJOY) Did you enjoy this activity?
- (GOOD) Did you think you were good at this activity?
- (AGAIN) Would you like to do this activity again (with different content)?

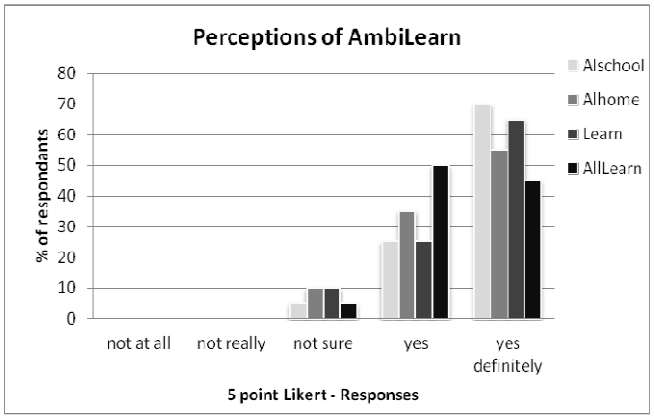

Figure 4 User perceptions of AmbiLearn (ALschool:ALhome:Learn:AllLearn)

The means in Table 2 show that the majority of responses remained on the positive side of the scale. AmbiJig (A-J) stood out at the most popular activity with 50% rating this activity as their favourite. The Wordsearch (W-S) activity showed surprising results as 35% suggest this activity was

their favourite whilst 60% rated this as their least favourite. It was observed during the study that this activity resulted in a highly active atmosphere in the school computer suite with quite a lot of collaboration amongst the participants.

TABLE II. MEAN REPONSE FOR EACH ACTIVITY

	A-G	W-S	F-M	A-J	A-Q
FUN	4.25	3.55	3.40	4.90	4.40
ENJOY	4.05	3.50	3.65	4.55	4.20
GOOD	4.00	3.25	4.00	4.75	4.10
AGAIN	4.25	3.85	3.75	4.60	4.30

Table 2 shows the mean response between 'not sure' and 'yes, a bit' for all factors of the wordsearch activity even when 90% of the respondents rated the activity as hard. The 10% who suggested the activity was not hard, also perceived themselves to be really good at the activity, which reflected in their game times which were faster than the whole class average. Throughout the TreasureLearn game the subjects score was available and highlighted after each activity. This was not drawn to their attention by the researcher. In an attempt to analyse whether a score in a game was a factor which influenced their perceptions of fun or enjoyment, they were asked what their score was. Results indicate that 25% of respondents remembered their score. When asked whether they would like to know the rest of their classes score the data shows 15% suggested 'not really', 10% 'not sure' whilst the remaining suggesting 'yes' (50%) and 'yes definitely' (25%). One observation at this stage was that those 15% who suggest they wouldn't really want to know the rest of the scores were all female. To identify if 'Ambi' the character influenced their game perceptions the participants were also asked if they felt happy and proud that they saved Ambi, to which 55% said 'yes, definitely'; 30% 'yes'; 5% 'not sure'; and 10% 'not at all'.

V. CONCLUSION AND FUTURE WORK

This paper presented background research into the use of virtual learning environments and serious games in education. With a focus on `assessments for learning', the design and implementation of AmbiLearn is presented including a generic game module complete with content creation and reporting module. A field study has been designed and is currently in progress to evaluate all three modules of the AmbiLearn architecture. This paper provides preliminary results obtained from one trial documenting children's perspectives of the AmbiLearn game module presented (TreasureLearn application). Further analysis is needed to identify any correlations between the influencing factors and those of age and gender. When more data becomes available the analysis will continue with a view to formally evaluate the educational potential of AmbiLearn.

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