Using LAMS to structure and support learning activities in virtual worlds

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Virtual worlds are being increasingly used in education, often for their flexibility in facilitating student-directed learning. As flexibility for self-paced learning increases, however, the challenge of guiding students' learning trajectories towards the intended outcomes also increases, as does the need to provide appropriate support and guidance. LAMS presents one method of structuring student activities while providing targeted support, and as such may be a useful tool for teachers educating within virtual worlds. This paper reports on the use of LAMS within a virtual world project with high school students, and identifies both opportunities and challenges for integration of LAMS and virtual worlds. Improvements are identified for further integration of LAMS and virtual worlds.

Keywords: LAMS sequences, alignment, virtual worlds, opportunities, challenges

Introduction

Virtual worlds offer opportunities for open-ended learning activities, such as simulations, role plays, design tasks, and machinima (video) development, in which students are encouraged to be creative and innovative while taking responsibility for their choices and activities. Within virtual worlds, learners are able to collaborate, move and explore, build, interact with virtual objects and media, and customise personae. Virtual world activities can utilise the wide range of possible behaviours to present students with choices and experiences that encourage consideration of issues relating to the content to be learnt.

These opportunities for open-ended learning activities come with difficulties, however. One role for educators is to guide students through a learning trajectory towards attainment of the learning outcomes, while supporting and scaffolding each student. This study explores one potential response to this challenge: using a separate software tool, the Learning Activity Management System (LAMS), to assist teachers to structure activities and provide learning support for students. The study encompasses four iterations of a design-based research project that is evaluating innovative and curriculum-centred applications of one virtual world, *Open Simulator* (OpenSim). The data gathered on student perceptions, combined with classroom observations, indicate several positives and challenges of using LAMS to structure virtual world activities. Furthermore, the data provide clear indications of areas in which further development would be beneficial to integrate LAMS with OpenSim.

Within this paper, the educational opportunities afforded by virtual worlds are discussed, with an emphasis on the need to appropriately guide and support students' learning trajectories. Then, options for the provision of guidance and support are presented, including a role for LAMS. The iterations of the research study are introduced, followed by a discussion of the data analysis. Finally, the benefits and challenges of using LAMS to structure virtual world activities are summarised, and an outline of a possible development program for integrating LAMS and OpenSim is presented.

Learning and virtual worlds

Virtual worlds are "electronic environments that visually mimic complex physical spaces, where people can interact with each other and with virtual objects, and where people are represented by animated characters" (Bainbridge, 2007). One recent report (Kirriemuir, 2010) states that virtual worlds are being increasingly taken up by educators, and notes eight trends in virtual world use in tertiary education in the United Kingdom: a decline in campus replication; improved ease of access; continued significance of voluntary and/or substantial effort by academics; ongoing funding restrictions; improved attitudes to virtual worlds in learning; increased exploration of alternatives to *Second Life*; the persistence of academics who continue to use virtual worlds; and the increased use of virtual worlds to connect distant people. These trends indicate that virtual worlds are a significant component in the future mix of educational technologies, while highlighting the ongoing challenges of resourcing virtual world projects.

Virtual worlds afford five types of learning tasks: spatial knowledge representation; experiential learning; engagement; contextual learning; and collaborative learning (Dalgarno & Lee, 2010). Designed appropriately, these tasks can foster higher order thinking. Table 1 provides some example activities that can be conducted within a virtual world. However, using virtual worlds will not automatically engage students in the higher order thinking that is desired by contemporary educators. As with other forms of education, educators need to carefully consider the mix of tasks, questions and challenges within the virtual world activity, to encourage learner to respond to the activity through higher order thinking.

Table 1: Higher Order Thinking activities in OpenSim

Conceptual Process Categories (Krathwohl, 2002)	*Example activities in OpenSim*
Creating	Planning and producing models using primitives (basic units of construction in the virtual world that may be created and transformed by users) and integrating these to generate new scenes and narratives. Planning and generating different personas after avatar creation.
Evaluating	Checking and critiquing design ideas, for example considering the extent to which a design solution meets requirements in terms of functionality, safety, sustainability and aesthetics.
Analysing	Differentiating between contrasting sculptures in terms of primitives used. Organising and attributing a combination of primitives to obtain a desired form in an efficient manner (for example, using the fewest primitives).

Two of the most significant issues highlighted within education research are the need to internally align the learning outcomes, assessment and activities, and to adequately guide and support learners throughout the entire process. Biggs (1996) provides a compelling argument for learning designers to carefully align the teaching objectives, learning activities and assessment. Through this alignment, he argues, it is possible to set up courses that provide clear objectives for students then provide the situations through which students are likely to elicit the required learnings, while gathering data that allow the teacher to make valid evaluations of the extent to which each student has achieved the objectives.

The trajectory of students within a learning activity is also of concern, especially when the activity is taking place within a virtual world that allows great latitude for play and other interaction. There is a risk that even when alignment between learning outcomes, activity objectives and assessment is achieved, students will engage in off-task behaviour, or lack clarity in how to achieve the expectations. Kirschner, Sweller and Clark (2006) advocate use of worked examples and process worksheets, to provide clear guidance for students. Another key source of guidance for students is formative feedback, which is best delivered when assessment methods and feedback channels are integrated into the activities rather than only occurring at the end of the activity (Black & Wiliam, 1998).

There are a few options available to virtual world designers in response to the need for structure and guidance. One currently used technique is to embed the alignment and supports for the students' learning within the virtual world. The use of this technique is exemplified by Quest Atlantis, a highly successful implementation of educational virtual worlds, which uses embedded narratives, called quests, to provide structure and guidance within the learning activities (for example, see Hickey, Ingram-Goble, & Jameson, 2009). Within each quest, a student will interact with Non Player Characters (scripted agents within the virtual world), objects and data within the virtual world. Students' trajectories within each quest are carefully directed so that students gain exposure to the relevant concepts and skills and have opportunities to apply these concepts and skills in ways that highlight their use for problem solving and reaching goals (Barab, Zuiker, Warren, Hickey, Ingram-Goble, Kwon, Kouper, & Herring, 2007). Students are supported by their classroom teacher, who reviews and marks quest submissions (assignments) and may provide additional direction and discussion when necessary. Embedding the activity alignment and guidance within the virtual world has also been used successfully in the virtual worlds of River City (Ketelhut, Nelson, Clarke, & Dede, 2010) and Virtual Singapura (Jacobson, Kim, Lee, Lim, & Low, 2008).

While embedding narratives within the virtual world has some clear benefits, there are also some significant limitations of this technique. Embedding narratives is labour intensive and requires significant technical understanding to program the NPCs. Flexibility is reduced, as the virtual space is bound up in that specific use and may be difficult to re-purpose for other educational activities or research objectives. Quest Atlantis, for example, adds new virtual worlds to cater for the new activities that are developed. This represents a considerable additional cost for technical infrastructure and support, which is not appropriate for smaller initiatives. Lastly, each virtual world platform has restrictions on the forms of interactions that may be embedded within them. OpenSim, the platform used in this research study, has severe restrictions on the forms of multimedia and interactivity that may be embedded within it. Other virtual world platforms do support a broader range of media and interactions, but present other undesirable trade-offs (difficulty in controlling access, and a lack of in-world construction tools).

An alternate method to embedding the narrative is to use separate software to structure the activity and guide the students. One system that has been widely used is SLOODLE, which integrates Second Life and Moodle to provide a three-dimensional virtual learning environment (Livingstone, Kemp, & Edgar, 2008). However, SLOODLE currently offers limited integration with OpenSim (SLOODLE, 2010), and a more stable technology was desired. An alternate system – and the one used in this project – is LAMS.

A role for LAMS

LAMS is “an online web-based system for creating, managing and delivering sequences of collaborative learning activities” (Cameron, 2007, p. 112). It features a visual, drag-and-drop editor, which allows designers to create a learning sequence from a variety of different activities involving different media and interactions. A LAMS sequence specifies the learning activities to be completed, as well as the workflow sequence to be followed. Students within a LAMS sequence are able to self-pace, by proceeding to the next activity in the sequence when they are ready to do so (although teachers are able to control and track students’ progress through the use of stop-gates and the monitor feature).

One of the benefits of the activity sequencing provided by LAMS is that it provides a tool for the implementation of the alignment of objectives, learning activities and assessment. Students can be oriented to the learning objectives at the start of a sequence, then engaged in interactions and collaboration that are likely to elicit the required learnings, while facilitating the collection of assessment data. Additionally, LAMS can also facilitate the delivery of guidance and learning support such as worked examples and process worksheets. In one research study, it was found that students valued the way that LAMS provided a connection between the content and the support material, with 14 of the 20 participants in the research agreeing that the statement that “Guidance and orientation using LAMS learning activities helped my study” (Pierrakeas, Papakadis, & Xenos, 2009). Within this project, LAMS is mainly used for information delivery and workflow structuring, while the majority of the students’ learning efforts are conducted while active within the virtual world.

The use of LAMS to structure learning activities within a virtual world has been discussed (Powell, 2007), but there is no published research that evaluates an implementation of the blending of learning through activities within a virtual world and LAMS. This paper reports on a research project that is exploring the use of LAMS as a tool to structure and guide students’ activities within a virtual world.

Project Overview

The research study reported in this paper was conducted as part of a project that aims to evaluate innovative educational applications of virtual world technologies, focusing specifically on activities that involve student construction within a safe environment. These activities are intended to provide students with curriculum-centred learning opportunities that involve deep engagement and higher order thinking. The project team aims to work with and support high school and primary school classroom teachers, to develop and evaluate units of work that have a critical learning component involving student design and construction within a virtual world. The units of work are examples of blended learning, as students may also complete other classroom activities and assignments that are conducted outside of the virtual world.

The virtual world platform being currently evaluated is *OpenSimulator* (Opensim), an open source platform that closely mimics the functionality of *Second Life*. Opensim was selected for the customisability of its set-up, which allows the project team to maintain strict access control to the virtual world, as well as the versatility of the in-world construction tools.

Four iterations of the project have been conducted (Table 2). The role of LAMS has been refined and modified through these iterations, to reflect the findings of the evaluations and the way that the project has transformed over time. The use of the LAMS sequence to provide structure and guidance was mainly evaluated within the Pilot Study, to determine whether this approach was appropriate for the project. In the subsequent iterations, the LAMS sequence underwent relatively small modifications, and the project's research focus shifted to other research questions. Nonetheless, significant benefits and challenges were identified in the later iterations and are reported on below.

Table 2: Description of Project Iterations

Iteration #	*Description*
1: Pilot study	Thirteen year 10 students, involving a 5 hour introduction to virtual worlds and training session on how to use the construction tools. The purpose of this pilot study was a proof of concept for using the OpenSim platform with the integration of LAMS and training videos to allow students to self-pace learning activities.
2: Student constructed artworks	Fifteen Year 9 Visual Arts students, involving a 10 week unit of work on design and construction of site-specific artworks. The students modelled their artworks within the virtual world, to test and refine their artwork design ideas. The students subsequently constructed the artworks at specific sites within the school, using physical materials.
3: Learning spaces (High School)	Twenty Year 7 Technology Mandatory students, involving a 10 week unit of work on design processes and sustainable café and learning spaces. It is hoped that elements of the students' designs will be incorporated into a café space that is to be built in the school.
4: Learning spaces (Primary School)	Fifteen Year 5/6 students, involving a four week unit of work on designing sustainable learning spaces. The students used the virtual world to design outdoor and classroom spaces, and elements of the students' designs may be incorporated into outdoor spaces and classrooms that are currently being built in the school.

As outlined above, LAMS was intended to provide structure and guidance for the learners as they progressed through the activities within the virtual world. Figure 1 depicts the LAMS sequence used for the initial activity in the Pilot Study: Avatar Customisation and Tower Building. The repeated use of the *Noticeboard* activity is indicative of the intentions for the LAMS sequence, that is, to structure the students' learning trajectories and provide learning support through gradual and sequential release of information and instructions. Internal alignment of outcomes, activities and assessment was achieved by providing clear expectations, learning intentions, and task requirements through *Noticeboard* activities, and facilitating assessment submission through the *Submit Files* activity. Learning support was also delivered through the *Noticeboard* activities, which included concept definitions and process instructions. One *Noticeboard* provided a link to a separate website which hosted additional support videos that demonstrated in-world construction skills. These videos were delivered externally to LAMS, to facilitate just-in-time student access. One video acted as a worked example, demonstrating how to complete the activity. Regular formative assessment was provided by the project team and classroom teacher, by walking around the room and discussing concepts and skills within the students. Occasionally, skills were demonstrated for the entire class using the interactive whiteboard. Additional research data were collected through the *Data Collection* and *Survey* activities. The *voting* activity was included to elicit a sense of community, with students indicating their favourite virtual world that they had previously been in. The other learning activities within Iteration 1 used roughly similar LAMS sequences.

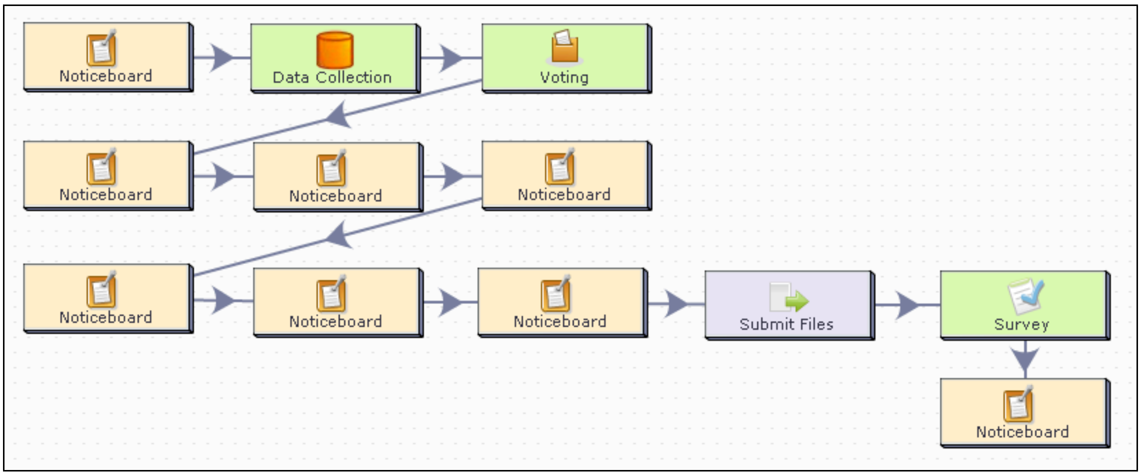

Figure 1: Sample LAMS sequence used in Iteration 1

In Iteration 1, data were collected regarding students' perceptions of LAMS, in addition to assessment data indicating attainment of learning outcomes. Observations from the project team also formed a significant source of data. Due to the change in research focus after this first iteration, less detailed student perception data was collected in the later iterations. However, detailed observations from the project team continued to be recorded and analysed, and contributed to the results below.

Results

Iteration 1

In the first activity, 11 of the 12 students who completed the survey reported that they found LAMS to be helpful or very helpful. Eleven students reported high levels of satisfaction with the activity. Overall, student achievement of learning outcomes was satisfactory. All students were able to customise their avatars and construct a tower, although one student was assessed at a 'basic' level of achievement which indicated that there remained significant learning to be achieved by this student.

Student perceptions to the second activity were fairly similar. Most students (8 of the 10 who completed the survey) reported high levels of satisfaction with the activity. Two students indicated that they needed clearer instructions, while the remaining students indicated that they needed further time to complete the activity. Again, student achievement of learning outcomes was mostly satisfactory to excellent, although there were two students who were assessed at a 'basic' level of achievement. One important piece of student feedback was the need to clarify the term 'contrast' in the task requirement.

Throughout both activities, the students were initially able to self-pace their progression by following the processes and instructions within the LAMS sequences. However, once the students were actively engaged within the virtual world, no student was observed proactively returning to the LAMS sequence to clarify task requirements or definitions, or move to the next step of the activity. Instead, once the students were satisfied with the completion of a task, they would explore or play within the world. For example, the assessment submission processes at the end of the activities needed to be initiated through intervention by the project team. The students did regularly and proactively refer to the support videos.

Overall, these results indicated that the level and forms of support being provided were generally sufficient (with the notable exception of the task requirement for the second activity), as was the level of internal alignment of outcomes, activities and assessment. However, the integration of the LAMS sequences with the learning activities within the virtual world was inhibited by the resistance of students to return to the LAMS sequence, indicating a limit on the ability of the LAMS sequence to guide students' learning trajectories through the activities.

Subsequent Iterations

The LAMS sequences were reused in the subsequent iterations, although with a few modifications. Research data collection was moved to another online system (SurveyMonkey), to conform to institutional requirements. Training activities were conducted over two days, to give students more time to practise and develop their skills. Although these iterations were full units of work, the LAMS sequences were only used for the training activities. The tight schedule for each iteration precluded comprehensive professional development for the classroom teachers for both the virtual world and LAMS. For this reason, it was not viable to expect the classroom teachers to design LAMS sequences for the units of work while also developing an understanding of how to educate within the virtual world.

The task requirement and conceptual support for the second training activity underwent further refinement, as students had highlighted these as an issue. On reflection, the core skill required for success in the training activity was determined to be the ability to manipulate the virtual object primitives into different forms. Thus, the LAMS sequence was modified to define 'form', then ask students to consider the link between form and primitives by completing an *Image Gallery* activity which presented a series of sculptures, highlighted contrasting features and posed questions on how the sculptures might be built within the virtual world. In Iterations 3 and 4, the *Image Gallery* was presented on an interactive whiteboard, for face-to-face group discussion. This allowed explicit teaching to explain the relationship between concept and application, perceived as the most efficient way of conducting this activity.

Another series of refinements concerned the desire for collaborative reflection. In Iteration 2, a *Chat* activity was added near the end of the second activity. Unfortunately, technical issues in the second iteration severely restricted network access and the chat and data collection were not completed, so that students had more time to complete the activity occurring within the virtual world. In the third and fourth iterations, the *Chat* activity was dropped in favour of a reflective blogging tool, *Edmodo*, which provided a single repository for all collaborative reflection throughout the project. This was favoured over the use of LAMS collaboration activities such as *Chat* as Edmodo provided a single stream of discourse across the different sessions, while facilitating tagging, searching and provision of formative feedback.

Students continued to express satisfaction with the outcomes of the training activities, and all students mastered the in-world construction tools to a sufficient level of expertise and designed appropriate virtual artifacts that met the design or artistic objectives of the unit of work. The students' ability to meet the intended learning outcomes, along with their positive learning experience, indicates suitable internal alignment of the activities as well as adequate levels of guidance and support. The use of the *Image Gallery* within the second LAMS sequence was well received by students in both face-to-face group discussion and self-directed modes, and students included many of the forms into their designs. However, the teachers observed that students continued to be very reluctant to return to LAMS once they were active within the virtual world, so the utility for providing learning support and guidance through LAMS remains limited to the times prior to activity within the virtual world. The opportunity for LAMS to guide students through collaborative reflection after completing a virtual world activity remains untested.

Conclusions

LAMS facilitates the process of constructive alignment promoted by Biggs (1996), by allowing teachers to set-up and implement sequences that consider the alignment between student orientation, task instructions and assessment workflows. However, LAMS is of less utility in guiding students when they are working within the virtual world. Once students are active within the virtual world, they are reluctant to return to the LAMS sequence. Instead, teacher intervention is required to progress students through different stages of an activity. The benefits and challenges that are present for integrations of LAMS and virtual world activities are summarised in Table 3.

The most significant challenge facing educators who wish to use LAMS to provide structure and guidance for virtual world learning activities is the difficulty of getting students to refer back to the LAMS sequence once they are active within the virtual world. There are a few possible resolutions that could currently be employed. As implemented within this project, there can be a greater degree of teacher direction, however this limits opportunities for student self-pacing. To overcome this limitation, an intervention may be possible to increase students' self-regulation processes, which should encourage students' ability and motivation to self-direct themselves through the learning activities (Boekaerts, Maes, & Karoly, 2005).

Table 3: Benefits and Challenges of using LAMS to structure virtual world activities

Benefits	*Challenges*
Facilitate internal alignment of outcomes, activities and assessment. Deliver content and encourage active engagement (for example *Image Gallery*). Deliver procedural instructions (for example accessing the virtual world and videos). Facilitate workflows (for example *Submit Files* for assessment). Reuse in later iterations.	Students' reluctance to return to LAMS after being active in virtual world reduces opportunities for student self-pacing through activities and accessing just-in-time support. In some project structures, professional development needs of teachers may inhibit ability to integrate LAMS into activities that are specific to the unit of work. Technical issues, which can impact both the virtual world and access to LAMS. Providing continuity over several sessions, for example maintaining a list of all reflective contributions over the entire unit of work.

The authors would also like to propose several possible technical solutions that could further integrate learners' experiences in LAMS and OpenSim (or other virtual worlds):

1. Add support within OpenSim for Adobe Flash to be displayed within the virtual world, so that the LAMS sequences could be presented on virtual objects such as walls. This would allow students to complete LAMS activities without switching their experience out the virtual world.
2. Integrate LAMS into OpenSim as a Heads Up Display (HUD), which forms part of the interface of the virtual world. The LAMS activities could be displayed as a separate overlay, to become part of the students' in-world experience, rather than tied to a specific location.
3. Once LAMS is integrated as a HUD, the ability for LAMS to be location aware (Evans, & Cameron, 2009) could be replicated within the virtual world, so that a specific LAMS sequence is initiated when the student moves to a specific location within the virtual world.

Currently, a blending of several technologies and techniques is required to provide structure, guidance and support within virtual world learning activities. In the future, however, there is great potential in streamlining learning in virtual worlds through further integration with LAMS.

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