LEARNING IN VIRTUAL WORLDS

RESEARCH AND APPLICATIONS

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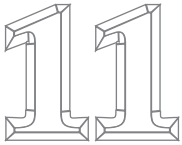

SCAFFOLDING LEARNING THROUGH THE USE OF VIRTUAL WORLDS

Chris Campbell and Leanne Cameron

Virtual worlds are being increasingly used in education, often for their flexibility in facilitating student-directed learning. They offer opportunities for open-ended learning activities, such as simulations, role plays, and design tasks in which students are encouraged to be creative and innovative while taking responsibility for their choices and activities. Within virtual worlds, students are able to collaborate, move and explore, build, and interact with virtual objects and media. As flexibility for self-directed learning increases, the challenge of guiding students' learning toward the intended outcomes also increases, as does the need to provide appropriate support and guidance (Cram, Lumkin, & Eade, 2010).

Some early research suggests that virtual worlds may provide pedagogical advantages for specific learning styles and learner groups, as well as for specific subject areas (Bradshaw, 2006; Roussou, Oliver, & Slater, 2006; Slator et al., 2005; The Schome Cmmunity, 2007). They provide students with the opportunity to collaborate, design, experiment with learning, and use different personas. The studies we describe in this chapter demonstrate that virtual worlds can be employed with students to enhance their learning through the use of well-structured scaffolding.

The first project we describe used Second Life (SL), which is a quickly evolving virtual world that remains one of the most accessible of the newer virtual worlds. The students were provided scaffolding through course readings, group presentations, immersion in the software, and experimentation within Second

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Life in a supportive classroom environment. These students used Second Life as a tool to equip themselves with the skills to critically and purposefully engage with emerging technologies in order to enhance their teaching practice.

The second project we describe explored an alternative virtual world platform, OpenSimulator (OpenSim). OpenSim can be used to simulate virtual environments similar to Second Life. The OpenSim virtual world can be accessed with the standard Second Life viewers; however, OpenSim is not a clone of SL. On the contrary, it lacks support for many of the game-specific features of Second Life (Overte Foundation, 2011). OpenSim was chosen in this case for the open customizability of its setup, which allowed the research team to maintain strict access control to the virtual world, and for the versatility of the inworld construction tools.

These studies used Second Life and OpenSim as examples of virtual worlds and as new technological tools that could be used in classrooms. In this chapter we analyze teachers' attempts to scaffold student learning, and how these evolved while students used the virtual worlds. In both studies, the researchers saw Second Life and OpenSim as accessible examples of virtual worlds, a rich social network, and a technological teaching tool new to the students.

Providing Scaffolding in Educational Settings

Using virtual worlds will not automatically engage students in the higher-order thinking that is desired by contemporary educators. To do this, teachers need to carefully consider the mix of tasks, questions, and challenges within the virtual world activity to encourage learners to respond using higher-order thinking (Cram et al., 2010). Two of the most significant issues highlighted within educational 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 learning objectives, activities, and assessment. With alignment, he argues, it is possible to set up courses that provide clear outcomes for students, provide appropriate activities through which students are likely to achieve these outcomes, while gathering data that allows the teacher to make valid evaluations of student achievement.

The path students take within a learning activity is important, especially when it is within a virtual world that allows great scope for play and other interactions. 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 expected goals.

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In both projects described in this chapter, providing adequate guidance and support—or scaffolding—for students was vital to their success. Scaffolding in educational contexts is a process through which the teacher provides students with a type of temporary framework for their learning (Lawson, 2002). This type of structure encourages students to develop their own initiatives, including motivation and resourcefulness. Structure is seen as the key. Without a clear and obvious structure and specifically stated expectations, many students are vulnerable to a kind of educational "wanderlust" that can pull them off task (McKenzie, 1999). Scaffolding can organize and support student investigation or inquiry, and keep them from moving too far off their learning pathway while still seeking "the truth" about the issue, question, or problem that was driving the learning activity. Learning occurs effectively when students have been well prepared, well equipped, and well guided.

Scaffolded instruction is "the systematic sequencing of prompted content, materials, tasks and teacher and peer support to optimize learning" (Dickson, Chard, & Simmons, 1993, p. 12). Students are generally given support until they are able to apply these new skills and strategies in an independent way (Rosenshine & Meister, 1992). Once students have gained knowledge and developed skills on their own, the elements of the supportive framework can be gradually dismantled (Lawson, 2002). Eventually, the scaffolding can be removed altogether as it is no longer required. This type of instruction has been recognized for its ability to engage students because they are constantly building on prior knowledge, forming associations between new information and concepts (Coffey, 2002).

The idea is for scaffolding to eliminate any distracting frustrations to the greatest extent possible, and to both maximize learning and efficiency (McKenzie, 1999). Students do not generally passively listen to information presented but, with teacher prompts, they are able to build on their prior knowledge and form new knowledge (Van Der Stuyf, 2002). Scaffolding presents opportunities for students to be successful before moving into further unfamiliar territory (Coffey, 2002).

This concept of scaffolding is based on previous work by Vygotsky, who proposed that with an adult's assistance, children could accomplish tasks that they ordinarily could not perform independently (Bruner, 1975). It is an instructional technique associated with the Zone of Proximal Development (ZPD), in which the teacher provides support by incrementally improving the student's ability to build on his or her prior knowledge: "The zone of proximal development is the distance between what children can do by themselves and the

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next learning that they can be helped to achieve with competent assistance" (Raymond, 2000, p. 176). When students are constantly supported by teachers within the ZPD, they are able to keep their attention on the task, are motivated, and actively working (Coffey, 2002). Upon completion of the task, students are better able to make the connection between prior knowledge and new information (Pennil, 2002).

Within this zone, students are constantly challenged, yet each component or concept is more accessible and less intimidating when it is presented gradually. The teacher demonstrates and models the successful performance while keeping the task at the proper level of difficulty. While doing this, the teacher must avoid frustrating students, as frustration with a concept or activity can cause students to become either discouraged or withdrawn. It is a delicate balance, as too much scaffolding can undermine a student's sense of accomplishment, but too little creates frustration and discouragement (Henry, 2002).

Scaffolding allows students to be self-reliant while they are still receiving support. The goal of the teacher when using this strategy is ultimately for the student to become an independent self-regulating learner and problem solver (Hartman, 1997). The dilemma created by this strategy has been outlined by McKenzie (1999, p. 1) who stated, "how do we provide sufficient structure to keep students productive without confining them to straitjackets that destroy initiative, motivation and resourcefulness?"

Supporting Students, Just-In-Time Advice, and Keeping Students on Task in a Virtual World

There are a few options available to virtual world designers in response to the need to structure and guide students' learning. One technique is to embed the alignment and supports for the students' learning within the virtual world. This technique was employed in Quest Atlantis, a highly successful implementation of an educational virtual world that uses embedded narratives, called quests, to provide structure and guidance within the learning activities (see Hickey, Ingram-Goble, & Jameson, 2009). For each quest, a student will interact with non-player characters (NPCs, also called scripted agents), objects, and data within the virtual world. The pathways within each quest are carefully directed so that students gain exposure to the relevant concepts and skills, and have opportunities to apply them in ways that highlight their use for problem solving and reaching goals (Barab et al., 2007). Students are supported by their classroom teacher, who reviews and marks quest submissions (assignments) and may provide additional direction and discussion when necessary.

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Educators have also embedded the activity alignment and guidance 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 to this technique (Cram et al., 2010). Embedding narratives is labour intensive, and requires significant technical understanding. 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 to the new activities that educators have develop. This represents a considerable additional cost for technical infrastructure and support, which is not realitstic for smaller projects.

Every virtual world platform has restrictions on the forms of interactions that may be embedded within them. OpenSim, the platform used in the second research study we report on in this chapter, has severe restrictions on the forms of multimedia and interactivity that may be embedded within it. Other virtual world platforms support a broader range of media and interactions, but present other undesirable tradeoffs, for example, difficulty in controlling access or a lack of inworld construction tools (Cram et al., 2010).

Rather than embedding the narrative, we describe some alternate methods of scaffolding in this chapter. In the Second Life project, the scaffolding was provided face-to-face on a just-in-time basis. The OpenSim project used a variety of Web 2.0 tools to structure student activity and guide the students.

Project 1—Second Life

This project focused on fourth-year pre-service education students, who were enrolled in an elective course called Interactive Technologies at La Trobe University during Summer Semester 2008. It was an intermediate educational technology course where students created websites, gained experience using interactive whiteboards, and learned about emerging technologies. Instructors taught the course in block mode over one month and included several assessment tasks, one of which covered the topic Second Life. By incorporating the use of Second Life into the course, the project's researchers hoped the students would undertake an enriched approach to using a new and emerging technology and have the opportunity to reflect on the unique characteristics of virtual worlds and their relevance to contemporary teaching practice. This was done through systematic scaffolding.

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Project 1 Methodology

Qualitative methodology within a case study framework was used for this study of 36 participants. The researchers collected data using a variety of qualitative methods, including questionnaires, focus group interviews, and online reflective journals written by students. The online journal was worth 10% of the total assessment for the course. Other data included lesson plans from each group and audio recordings of class presentations that utilized Second Life. Since the instructor taught the course in block mode, the entire class went for five weeks, with students participating on several full days. This project had ethics approval from the university and students were required to sign a consent form prior to participating. Their participation was not compulsory, and they were able to withdraw from the study at any time.

The participants were all of the students from the two classes involved in the study. However, not all students participated in the final questionnaire or the focus group interviews, with 25 students completing the final questionnaire. There were two focus groups from each of the two classes. One of the limitations of this study is the small sample size, but as this is a pilot study, it could perhaps be repeated at a later time, thus adding to the rigour of the findings.

Participants completed one online questionnaire at the beginning of the course and another at the end, both in SurveyMonkey. The questionnaire contained a mixture of open-ended and closed questions, including matrix style questions that focused on students' ICT use, such as general use of technology both at home and at work, mobile phone usage, email, social networking website use, and any preconceptions they had of Second Life prior to being introduced to it. Students were asked if they had used Second Life previously, and how they thought they may be able to use the virtual world for educational purposes. They were also asked about other virtual environments and if they had used them before. The final questionnaire asked students about their use of Second Life during the course (e.g., number of hours of use) as well as whether and how they anticipated using Second Life for educational purposes in the future, including in their professional practice as teachers.

To add depth to the data, the researchers conducted focus group interviews at the end of the course. At this time students were asked about their experiences using Second Life both prior to and during the class. They were asked about the learning activities they created in class, if they thought they would use Second Life in the future, and if they felt they might use Teen Second Life in their own classes once they became qualified teachers. There were two groups who

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participated in the focus group interviews from each of the separate cohorts, with a total of 24 students participating. Students had access to their own online journal in the university's Learning Management System (LMS), which was kept private between the course instructors and the individual. In it, the students were able to reflect on their experiences in the course such as working as a group, moving their avatar around in Second Life, and the advantages and uses they thought virtual worlds would have when they became classroom teachers. They were able to reflect on class discussions about the learning styles teaching with Second Life might be useful for, and how it may fit in with the curriculum taught in schools in the Australian state of Victoria, or extracurricular activities. The journal was designed to be open ended so that students could record any of their thoughts and not just comment on the suggested topics. The journal was not meant to be an arduous task for the students, and so the researchers expected they would complete approximately five entries, although some did more than this. The students were also given two academic articles on Second Life: Bradshaw's early paper on virtual worlds and pedagogical reflections (2006), and "Virtual or Virtual U: Educational Institutions in Second Life" (Jennings & Collins, 2008), as well as the report on the Schome Community (2007). Class discussions also revolved around these readings.

The researchers collected and then synthesized data from the participant questionnaires, focus group interviews, and other sources. They then categorized and explored emerging themes. Once the categories were assigned, the analysis relied heavily on description rather than inference. This allowed the researchers to do a broad analysis, as this was a pilot study and thus unexpected themes were likely to emerge.

The Learning Activity

Working in groups the pre-service education students were introduced to Second Life, and using an inquiry-based learning model they completed a scenario that required two class sessions of approximately 1.5 hours each. Day one consisted of the students initially exploring Second Life and listening to a presentation that included a history as well as practical information about the virtual world. After this presentation the students were given login details and then signed into Second Life in groups and began exploring, figuring out how to navigate, fly, talk, and engage in other inworld skills.

The students were given focus questions so that after they learned how to use basic inworld navigation they actually investigated how high school

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students might use a virtual world as a learning tool, and how Second Life might teach teenage students in a different way than conventional classes.

In their second session, the pre-service education students were given an inquiring and designing task to complete. This was a problem-based learning experience: the task was for the students to design a learning activity using Second Life that they wanted to try with a high school level class. The learning activity needed to support inclusive practices, that is, it had toensure everyone's learning needs were being met. The pre-service education students were then required to examine a scenario they were given, decide how to approach the task, assign roles, and then locate and analyze recent Second Life research. After reflecting on the research they found they had to identify their cohort, including relevant curriculum and learning objectives. The students then began designing their learning activity.

The third session involved each group of students giving a five-minute oral presentation to the class. Groups were self-selected and made up of approximately four students. Each group also wrote a 500-word summary called a learning activity report. This briefly described their learning design, including a rationale and critical reflection, and was later emailed to the researcher. The presentations were audio recorded, and the entire class reflected on the activities presented after each group's presentation. The class then reflected on using Second Life as an educational tool.

Student Improvement

By the end of the sessions the pre-service teaching students had created a variety of learning activities to use with secondary students. They mostly used environments already available in Second Life and Teen Second Life, although one group's activity involved using building skills to create the ideal classroom. Different groups focused on activities such as

- Cyber bullying
- Going on an excursion
- Mapping
- Languages other than English (x two groups)
- Scavenger hunt
- Role-playing occupations
- Communication skills
- Students building/creating an ideal classroom
- Exploring water channels, i.e., mathematical angles, depth, and volume.

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The pre-service education students took this problem-based learning task very seriously and produced quality detailed summaries of their activity. The summaries included learning objectives for the activity and evaluation and assessment sections. Once the researchers reviewed the students' presentations, it was evident that the designed learning activities were quite practical lessons that utilized the available resources well.

The majority of the pre-service education students, 87%, thought the activities they created during the class would work in environments such as Teen Second Life. One student reported, "students are always willing to try new things, and technology is in this day an [*sic*] age a very popular means of doing so. Our activity—re-design and build your own classroom—i [*sic*] feel would be appealing to teens in Teen SL," while another also thought that Second Life "encourages students to develop their technical skills in Second Life." A third student stated, "students will realize that there is an educational purpose for using SL, not just socializing. If they respect that, they are likely to appreciate SL as a different type of learning tool within a unit of work." Overall, the students felt that the scaffolding assisted them in using Second Life and helped them to complete the activities. One student stated, "the immersion in these activities and the rich learning that they could provide would be a very powerful tool to incorporate into the classroom," while another commented, "before this activity I was really struggling to see any educational uses for Second Life." The students also indicated that the scaffolded activity helped them develop their ideas.

Structure and Scaffolding Activities

A series of highly scaffolded activities provided the students with some valuable hands-on experience, as most had never been inworld. These activities were designed to provide minimum risk for the students new to the environment and get them quickly familiar with it so that they became comfortable enough to explore and complete the tasks asked of them. The majority felt that completing the activity with the scaffolding made them more comfortable exploring new technologies. In the final questionnaire, one student stated, "I may not have looked at these emerging technologies if they were not introduced into this class." Another declared, "practice and sharing information in the classroom (lab) is great, it's when I do the most learning!" A third student had this perspective: "having been in Second Life at the Uni, I am more willing to try it at home and also to try other new technologies." However, one student disagreed with these statements, as she or he "was already comfortable exploring

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all areas of technology." With the exception of the last, these statements suggest that the scaffolding of the activities was successful.

Opening up the possibilities of using virtual worlds in the classroom with a cohort of pre-service teachers who had never experienced one was a challenge. However, the scaffolding provided by the study proved to be extremely effective.

Project 2—Exploring Construction using OpenSim

The second project focused specifically on activities that involved students developing construction skills within a safe environment. This project looked at the potential for students to learn design and construction within a 3D virtual world, and then apply their learning to real-world contexts. Using the OpenSim virtual world, this project employed a variety of Web 2.0 tools to structure student activity and provide guidance.

The Learning Activity

Two high school classes completed one unit of work on site-specific artworks, intended to develop students' appreciation and application of spatial awareness. One class designed and refined their ideas using the OpenSim virtual environment, while the other class used traditional concrete materials. To begin, both classes learned appropriate concepts and techniques by visiting a real world exhibition and completing classroom activities. Then, the students conducted a survey of a specific site within their school, taking photos and running an analysis. One class learned construction techniques within the virtual world, and designed and refined their models using sites in a virtual environment that simulated the actual spaces in the school for the final art installation. The other class learned construction techniques using concrete materials, then designed and refined their artwork ideas using those materials. After the models were constructed, students joined groups and constructed a final large-scale art installation at the selected site within their school (Lumkin, Eade, Cram, Buck, & Evans, 2010).

Students initially completed two days of training, involving discussions of cyber safety, activities covering design and construction, and an introduction to online tools. After this, they worked in the classroom, with lessons focused on either design and construction activities within the virtual world, or a PowerPoint activity designed to develop their conceptual understanding. The design and construction lessons had a consistent structure, with 10 minutes allocated for planning, 30 minutes for completing the design and construction within the virtual world, and then 10 minutes recording progress and reflecting on the lesson.

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A range of scaffolding materials and techniques were included to support student activities; classroom teachers and the Macquarie ICT Innovations Centre team provided feedback, both face-to-face and using a number of online tools. These included a variety of images and videos depicting learning spaces provided through the online tools, a sustainable learning spaces checklist to support students' evaluations of their designs, and a measurement post with height demarcations within the virtual world to help students check the scale of their objects. The students were encouraged to provide peer and self-assessment both in the virtual world and using the online tools (Lumkin et al., 2010).

Project 2 Methodology

The project was a joint venture between a NSW Department of Education school and the Macquarie ICT Innovation Centre based at Macquarie University. Two co-educational high school classes participated, each consisting of one teacher and 15 students. A wide variety of research data was collected during the OpenSim project. The research methods chosen for the project were selected for their ability to record innovative teaching; the instruments needed to be able to report on student-centred pedagogies, learning beyond the classroom, and the use of a virtual world in teaching and learning, then translate what was being reported into measurable indicators. The researchers collected data via survey instruments and classroom observation protocols.

Both students and teachers filled in a survey before and after the project. Additionally, the researchers conducted post-training session surveys with all participants to determine the effectiveness of the training. The teachers and researchers documented classroom observations. Classroom teachers were also able to collect and evaluate the artifacts of the project. These included the students' visual arts process diaries and design portfolios, which provided documentation of each student's learning process throughout the project. Additionally, students' work from the project was evaluated in a presentation of each group's final product, the installation of their artwork. Prior to the study, the researchers gained ethics approval through both the university and the New South Wales Department of Education and Training.

The Learning Activities

These classroom activities were intended to provide students with curriculum-centred learning opportunities that involved deep engagement and higher-order thinking (Lumkin et al., 2010), with an emphasis on the need to appropriately guide and support students' learning. To ensure students were sufficiently

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scaffolded and supported, this project combined the OpenSim virtual world and two Web 2.0 tools, LAMS (Learning Activity Management System), and Edmodo with training videos.

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 that allows designers to create a learning sequence from a range of different activities involving various media and interactions. A LAMS sequence specifies the learning activities to be completed, and the workflow sequence that should be followed. Students within a LAMS sequence are able to pace themselves by proceeding to the next activity in the sequence only 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 to implement the alignment of objectives, learning activities, and assessment. Students could be oriented to the learning objectives at the start of a sequence, and then engaged in interactions and collaborations that are likely to elicit the required learning, all while assessment data can be collected. Additionally, LAMS can also facilitate the delivery of guidance and learning support such as worked examples and process worksheets.

One activity provided a link to a separate website that hosted additional support videos demonstrating inworld construction skills. These videos were delivered externally to LAMS, to provide just-in-time student access. The video acted as a worked example, demonstrating how to complete the activity. The research team and classroom teacher provided regular formative assessments by walking around the room and discussing concepts and skills with the students. Occasionally, teachers demonstrated skills for the entire class using the interactive whiteboard. The voting activity was included to elicit a sense of community, with students indicating their favourite virtual world prior to the class (Cram et al., 2010).

In the first activity, 11 of the 12 students who completed the survey reported that they found the scaffolding provided via the LAMS software to be helpful or very helpful. Overall, student achievement of learning outcomes was satisfactory. All students were able to customize their avatars and construct a tower, although one student was assessed at a "basic" level of achievement, which indicated that he or she still had several learning goals to reach.

Throughout the activities, the students were initially able to pace their progression by following the processes and instructions within the LAMS sequences. However, once the students were actively engaged within the virtual world,

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none were 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 by the research team.

Overall, these results indicated that the level and forms of support provided to the students were generally sufficient, 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 their learning pathway through the activities.

On reflection, the researchers determined that the core skill required for success in the training activity was the ability to manipulate the virtual object primitives into different forms. 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 in the virtual world. The teacher presented the image gallery on an interactive whiteboard for face-to-face group discussion. This allowed the teacher to explain the relationship between concept and application, which was determined as the most efficient way of conducting this activity. Another series of refinements concerned the desire for collaborative reflection (Cram et al., 2010).

In the later iterations of the project, the LAMS 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 provided a single stream of discourse across the different sessions, facilitating tagging, searchability, and a platform for formative feedback (Cram et al., 2010).

Edmodo was introduced as a reflection and collaboration tool for students to use throughout the unit of work. It is an enclosed, safe and secure microblogging environment where students were able to record their development and evaluations of their design process. It allows teachers to attach documents, embed media, send links and assign homework, and grade student work. Using Edmodo, teachers could provide information, suggestions, and feedback to students during the unit (see Figure 11.1). The use of Edmodo in this project had a major impact on how learning was supported within this unit of work. Students used Edmodo to describe and document their work, to explain and

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justify their designs, and to collaborate with their peers both during and outside school hours (Lumkin et al., 2010).

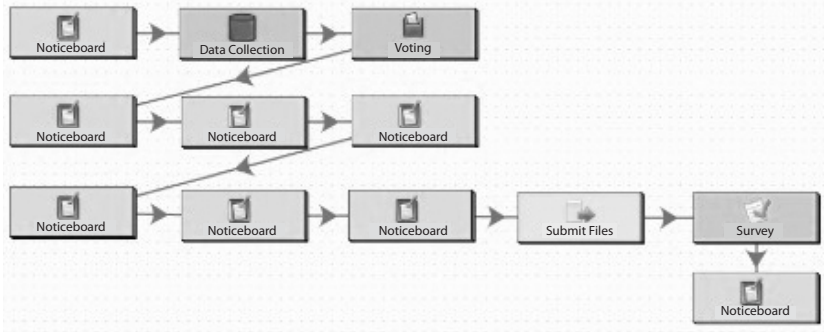

Figure 11.1 An example of a LAMS sequence.

Edmodo was effective in facilitating student reflection and collaboration while also recording each student's design process. Their initial use of Edmodo was scaffolded through participation in a joint construction and recount exercise using the interactive whiteboard to describe what and how their sculptures were constructed in the second training session. Students were also assigned a basic research task as homework to encourage them to use Edmodo at home (Lumkin et al., 2010). The research team recommended the use of Edmodo in future implementations, to complement student activities within the virtual world.

Instructors and research team members also encouraged and supported peer and self assessment within Edmodo and while in the virtual world.

Structure and Scaffolding Activities

The research team found LAMS was valuable in scaffolding students because it can provide a connection between the content and the support material (Pierrakeas, Papakadis, & Xenos, 2009). Within this project, it was mainly used for information delivery and workflow structuring, while the majority of the students conducted their learning efforts when they were active within the virtual world. Elsewhere, Powell (2007) discussed the use of LAMS to structure learning activities within a virtual world.

LAMS was intended to provide structure and guidance for the learners as they progressed through the activities within the virtual world. Figure 11.2 depicts the sequence used for the initial activity in the pilot study: avatar

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customization and tower building. The sequence was used to structure the students' learning pathways 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 these activities and facilitating assessment submission. Learning support was also delivered throughout the activities, which included concept definitions and process instructions (Cram et al., 2010).

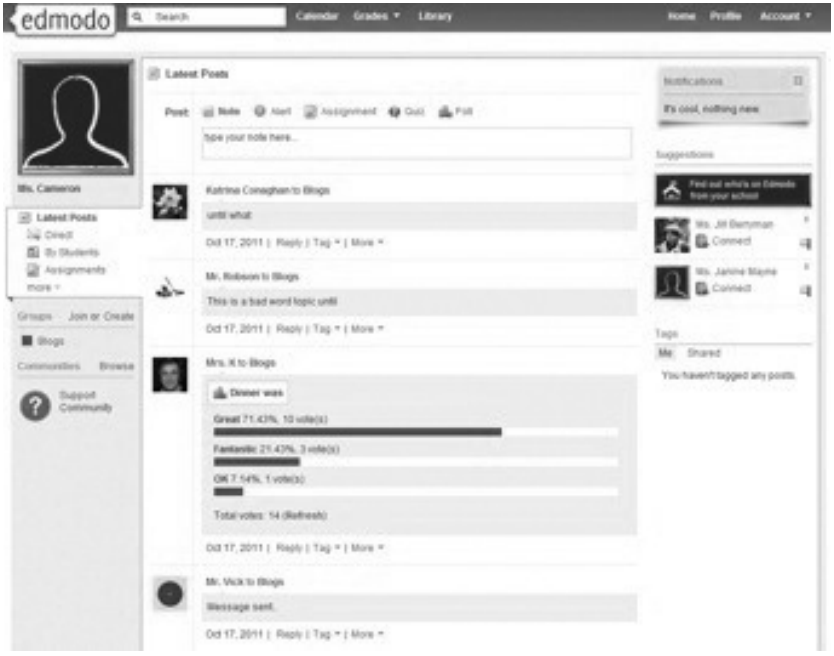

Figure 11.2 An example of an Edmodo site page.

How Teachers Can Facilitate/Support On-Task Behaviour in the Virtual World

In this section we focus on how teachers can facilitate and support on-task behaviour in virtual worlds. In both the projects we have described, providing appropriate just-in-time guidance and support (scaffolding) for students was seen by the respective research teams as vital to the success of the projects. By providing clear instructions that outlined the process in manageable stages, students were less inclined to stray from the set task. These projects clearly demonstrated that when students are well-organized and supported, they learn effectively.

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There are three key ideas that this research developed:

- Timely feedback
- Collaboration (both teacher–student and student–student),
- Keeping students on task.

Timely Feedback

In both projects the researchers found that providing immediate feedback to students had a major impact on the final outcomes of their activity. In the OpenSim project, students were able to act on teacher responses, and other students could also see responses. Laurillard's (2002) Conversational Framework highlights the significance of teacher–student and student–student discourse in learning. The fact that students used Edmodo to reflect and record ideas and modifications to the design, and used chat within the virtual world, are evidence to support this. Teachers were able to immediately direct the skills of their class in order to achieve the outcomes (Lumkin et al., 2010). One example of this is evident from the OpenSim project in size and scale: "if your avatar is standing near the items, compare this and ask yourself if the size is correct. Think of yourself using this item" (Lumkin et al., 2010, p. 42). Students were able to move on when faced with a difficulty they would have otherwise not been able to solve immediately themselves. This is also evident in Project 1, where students were able to reflect on how they used Second Life and document this in their journals. They were then able to use the discussion board to ask any questions they had as well as bringing them up in class.

Collaboration

In the OpenSim project, collaboration was a central component of student activity due to the requirement that students work in groups to complete their design and construction task. The collaboration occurred during face-to-face interaction within the virtual world and through Edmodo (Lumkin et al., 2010). Peer and self-assessment were also encouraged and supported both in Edmodo and Second Life.

The Second Life Project also supports the notion of collaboration being integral to teachers facilitating and supporting students in virtual worlds. This is evident from the student-centred tasks they were required to complete.

Keeping Students on Task

Scaffolding also provided increased opportunities for students to stay on task. One teacher noted that he " . . . did not experience one student log onto any

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page on the Web that was not directly related to exactly what they were doing" (Quote from teacher Robert Croucher in Lumkin et al., 2010, p. 41).

Future Directions and Conclusion

Although there is a lack of research relating specifically to scaffolding and virtual worlds, scaffolding is a well-established approach that has been widely used and studied in a range of traditional and technology-enhanced/technology-mediated educational settings. Our research here shows that providing systematic scaffolding is successful as it provides students with a temporary framework for learning (Lawson, 2002).

As reported by Cram et al. (2010), it is important to provide support and guidance to students so that they can achieve the intended learning outcomes. These projects demonstrate that by providing this support and guidance, students are able to suceed with their learning. The projects also demonstrate how scaffolding can organize and support student investigation or inquiry, and keep them from straying too far off their learning pathway. Because they were introduced to virtual worlds with well-structured tasks, course readings, group presentation assignments, immersion in the software, and time for experimentation, the students achieved their learning outcomes effectively and efficiently, and without undue levels of frustration.

We believe it is worth conducting further research into the use of scaffolding in virtual worlds, particularly with regard to the various types of scaffolds available, how they support students, and how effective they are.

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