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Educational assessment in virtual world environments

Torsten Reiners (t.reiners@cbs.curtin.edu.au)
School of Information Systems, Curtin University

Sue Gregory (sue.gregory@une.edu.au)
School of Education, University of New England

Heinz Dreher (h.dreher@curtin.edu.au)
School of Information Systems, Curtin University

Facilitating and empowering learners and teachers through technology has primarily concentrated on content and management aspects rather than on assessments aspects of the education enterprise. Recent developments in virtual world technology have sparked a raft of projects exploring the possibilities to enhance learning outcomes. In this article, automated support for educational assessment is focussed on via three case studies implemented in Second Life, the 3D virtual world implemented by Linden Labs. This paper discusses the assessment tasks, the methods used and provides an analysis of our results. The University of Hamburg case study involves scenario-based software development projects. The Curtin University case study focuses on simulating the business processes of the Automated Assessment Lab, which provides automated assessment opportunities to staff of the Curtin Business School, and in which a virtual world model of the entire assessment life cycle is created. A third case study from the University of New England, VirtualPREX (Virtual Professional Experience), explores self, peer and academic formative and summative assessment in virtual world role-play scenarios. Each case study comprises a description of intent and implementation, followed by evaluative comments from the role players, providing insight into the benefits that may accrue from the use of virtual world technology for students, teachers and educational administrators.

Keywords: automated assessment, virtual worlds, second life

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Introduction

Teaching and *Assessment* in education are fundamental to student learning. As teachers, we seek to provide rich learning experiences for our students and have been ready to embrace educational technology and innovations in learning systems. Perhaps the most prominent example of this is the use now being made of Learning Management Systems (for example Moodle, BlackBoard or Sakai) and the proportion of educational offerings (called "units", "subjects" or "study units" in some Australian universities, and "courses" elsewhere) that now have an on-line component. Educational administrators also are eager to take advantage of the new technology and wish to promote consistency, quality, increase efficiency, reduce costs, all the while making the educational offering more attractive in the marketplace. Research, development and application of technology to *Teaching* have seen considerable change over the last decade or two. By comparison, the attention paid to technology support for *Assessment* is in its infancy.

One technology now receiving increased attention is that of virtual worlds, popularized by Second Life. Within the past five years, virtual worlds have matured to become an educational environment to equip the academic with a variety of tools to implement innovative educational scenarios and methodologies for both teaching and assessment (Montalbano, 2010) or simulations (Farley, 2007).

Our investigations observed virtual worlds to explore how they can be utilized to improve the engagement in classes and projects and support the assessment process itself. Via three case studies we describe how educational assessment may utilise virtual world technology. This paper explores three case studies outlining how students used the virtual world (Background and Context), the Case Studies, the methods for assessment (Methodology) and discussion on the analysis of the assessment tasks (Analysis of Case Studies), concluding with Future and Conclusions.

Background and context

Virtual worlds are "well suited for project-based experiential learning" (Jarmon et al., 2009) where the focus is set on the experience for, and involvement of, the learner. Traditional lectures presenting slides and encouraging discussions are possible and widely done (Anderson & Sommer, 1997), even though this would neglect the real advantage of the technology. Benefits often associated with virtual worlds are, among others, communication, collaboration, social interaction, shared spaces, immersive and persistent environments, enhancing motivation, and realizing opportunities for ideas (Gregory, Reiners, & Tynan, 2010). Therefore, virtual worlds are often applied in the context of simulation and role-play, where real-world scenarios are transferred for experiments in safe environments; safe with respect to health (flight simulator, propagation of viruses), economic (modification to supply chains, influence of changing markets), society (changes on tax or health system, influence of crime statistics), or individuals (anonymous role-play, therapy). In comparison with other learning environments, virtual worlds emphasis is on collaboration, communication, and, therefore, on social skills, which implies the opportunity of enhanced assessments taking, not only the gained knowledge but also, the whole experience into account; see Kim and Kim (2010) for examples in the context of mental illness. Incorporating scripted scenarios and automated avatars (bots - non-player characters), virtual worlds allow individualizing the environment and gaining independence from others to perform a role-play (Park et al., 2009). The number of experiences can be multiplied for therapy and training as well as controlled to provide the same conditions independent of mood and exhaustion of others over an exam or testing period. Training extreme situations can require realistic settings often not achievable in the real world. While fire-fighters or nurses should have real-world training, routine and rare situations can be trained and assessed in virtual worlds (Chodos et al., 2011; Beard, et al., 2010). Authentic learning activities can be undertaken in a virtual world where it is either impossible or difficult to undertake in a real world (Lombardi, 2007).

In contemporary education environments, nearly all documents are created in digital form as 'Word' files, 'PowerPoint' slides or PDF documents, for example. In terms of process efficiency it is compelling to provide a digital ecosystem for the entire life-cycle of such documents. In the case of assignments, this includes the submission, acceptance, grading or assessing, feedback provision and results release phases. Better control and management of the entire process is a distinct advantage over a paper-based system, but when automated assessment and feedback provision is added to the life cycle, such as is possible using the MarkIT™ Automated Essay Grading System (www.essaygrading.com), additional benefits may accrue from reduced cost, drastic shortening of assessment cycle (to just a few minutes as opposed to many days) and superior consistency of assessment. In combination, these factors provide a considerably enhanced assessment experience for the student and an overall improvement in the quality of educational offering through the use of digital ecosystem based technologies and processes.

Assessment in virtual worlds, and especially defining a rubric, is still subject to further research. A recent development can be found in Weinberger et al., (2011). IGGY (2010) shows that educators apply traditional rubrics as they would do for projects but do not consider the unique features of virtual worlds. In-world (in Second Life) is seen as an extension of the real classroom, where the final assessment is done. Most educators use, to some extent, formative assessment. It might be important to mention that an observed increase in quality might result from getting credit for mere participation and that the sample of students in virtual worlds is biased, as it is more likely for better students to choose experimental environments.

On the other hand, some rubrics can be found that include categories for the environment and social interdependencies with others. Even though most would be valid in traditional Web-environments, the specialized rubrics emphasize the difference to a classroom and the new skills students can and must learn, and encourage students to take advantage of the offered features rather than just doing the assignment. Examples for specialized categories are *art* and *design* (to what extent are the features of the environment used to improve the results), *digital skills* (usage of the interface and taking advantage of available tools), *netiquette* (communication, use of language, and behaviour towards other participants), *interactivity* (implantation of scripts and how they interact with the environment), and *collaboration* (integration in the team and working as a team) (VieW, 2011; Morillo et al., 2010).

Case studies in second life

The island *University of Hamburg (UHH)* opened in 2007 and focussed on projects initiated and undertaken by the students as part of their software development education. Prior to the use of virtual worlds, a shift was noticed towards learning about technology and programming, with other stages of the software development process almost having no influence. This resulted in low motivation and the students' main focus was not on the programming. Moving to Second Life, the time for getting acquainted with the tools and the script language is minor compared to understanding PHP or JavaScript, allowing for more time on the planning and specification of tasks. The use of objects and messages – the main form of communication between objects in Second Life – for interaction goes along with the concept of object-oriented languages and thus mediated the same knowledge as previous courses on programming and software development. The core concepts and ideas could be transferred to virtual worlds without losing the context of the course, while the strong focus on visualization even support learners who had difficulties understanding abstract methods. In addition, the environment encouraged students to engage in new ideas and go beyond a prototype stage, as it was immediately public; see the next section on case studies for further feedback and details about how the projects were assessed. An overview of projects is given in Reiners (2010).

In 2009, *Australis 4 Learning*, an island in Second Life, was created to pursue several projects. Curtin University (Curtin) created a simulation of their real-world Automated Assessment Lab (Dreher, Dreher, & Reiners, 2008) business processes. Besides providing students with access to in-world tools to submit assignments and review their results, the technology was used to demonstrate the whole process from assignment specification through assignment submission and to (automate) marking; especially to advertise the advantages and lower the barrier for non-technology adverse educators. Users are guided along the different stages, receive an insight viewed by automated avatars and could experience various technologies for assessing assignments. The Automated Assessment Lab was established to provide a university-based automated essay grading service and research centre.

The University of New England (UNE) also established a space on *Australis 4 Learning*. A primary school and playground were created where students could meet, discuss assessment tasks, attend virtual tours and excursions, interact with guest lecturers, go on web quests, learn basic building and scripting skills and partake in role-play activities. More recently, further classrooms have been created for synchronous role-plays of teaching in a virtual world where pre-service teachers undertake the role of either a teacher or primary school student and role-play a short lesson (VirtualPREX – virtual professional experience). The pre-service teacher presented their own lesson to peers who were provided with roles to play as primary school students that were either "good" students or "naughty" students. The Second Life space has been created so that authentic learning activities can take place through formative and summative assessment of role-plays, through reflection and machinima (in-world video).

Over the past three years, virtual worlds have been applied in the context of assessment from several perspectives. The following overview depicts three examples and derives models of how to project the lesson learned on future scenarios; i.e. with respect to the ongoing project Virtual Professional Experience (VirtualPREX project information: Gregory & James, 2011 and http://www.virtualprex.com).

The island, *University of Hamburg*, was focussed on student projects. Originally, this was a course unit about developing software artefacts by teams of two to five students. Knowing about the different work environments and how the projects were approached, a rubric was adopted for assessing software development; especially integrating achieved and applied (technological) skills with respect to managing the process and the teamwork. Even using tools to monitor activity and authorship of submitted documents, the authenticity could only be identified by questioning the results through oral exams. Furthermore, a decrease in interest was noticed as projects often resulted in (unfinished) products in archives rather than being sustainable and accessible afterwards. Moving to virtual worlds contributed in multiple ways. First, by keeping the island public, access by supervisor and public was given at all times, encouraging the students to focus on their work and achieving a finished product. The additional (formative) feedback from sources other than the supervisor supports this engagement and results in higher marks. Second, the progress is visible at all time, allowing for immediate intervention in case of deviations from time plans and specification done in the first stages of the project. Rather than requesting (executable) milestones, the construction site can be visited any time. Third, monitoring of involvement is improved. Even though others could control avatars, they would be confronted with a higher risk

of getting caught due to the publicity. The importance of working as a team where everyone contributes to the outcome were discussed in advance and agreed on by all participants.

In addition to scenario-based projects on the island *University of Hamburg*, addressed were the self-guided learning and assessment of students. The harassment simulator is one example briefly discussed here as it demonstrates the advantages of avatars and scripted environments for formative assessment of specific situations in a self-guided environment (Reiners et al., 2010). The challenge for this project was having an environment where individuals could learn about workplace harassment in a secure setting to identify potential risks. Rather than having real-life role-play situations involving other *real humans*, the simulator enabled selection from a range of different avatars to experience everything while keeping a distinct distance. In the current simulator, the avatar has to cross an open-space office in different outfits while comments from co-workers are played. The answers have to be ranked (good, neutral, offending) for later evaluation, where experts put the outcome in relation to expected reactions. Each successful simulation is analysed and summative as well as formative feedback is provided to the students.

Curtin University on *Australis 4 Learning* focuses on a backstage perspective to assessment. A guided walk-through tour demonstrates the processes in a digital ecosystem view through the Automated Assessment Lab (AAL) and visualizes opportunities for the future by utilizing innovative technology such as automated essay grading (Dreher, 2009; Dreher, et al., 2008; Dreher, 2006).

Stakeholders of the assessment life-cycle, for example, students, educators, markers, or educational administrator, can *visit* each step and experience these by interacting with the digital artefacts. That is, receiving an assignment specification in the lecture hall, writing text, submitting it in a drop box, reading about how marking is done and viewing formative feedback on an individualized wall or mobile device. The AAL is also part of a software development course where students build artefacts for assessing virtual world projects as well as improving the AAL at the same time.

VirtualPREX on *Australis 4 Learning* is a project exploring self, peer and academic formative and summative assessment in virtual world role-play scenarios. Pre-service teachers are provided with the opportunity to experiment with their teaching prior to embarking on real professional experience. Formative assessment is embedded in a way that is valid, reliable and feasible to implement. The formative assessment procedure for VirtualPREX follows Boud's seven propositions for assessment, (Boud, 2010): assessment is used to engage students in learning that is productive; assessment is recognized as a learning activity that requires engagement on appropriate tasks; feedback is used to actively improve student learning; students and teachers become responsible partners in learning and assessment; students are inducted into the assessment practices and cultures of higher education; assessment for learning is placed at the centre of subject and program design; assessment for learning is a focus for staff and institutional development; assessment provides inclusive and trustworthy representation of student achievement. Assessment around engagement, appropriate tasks and feedback were addressed in the design of assessment tasks providing authentic learning and assessment for students. A set of structured, collaborative role-plays were developed to provide scenarios of common and challenging situations faced by teachers in the classroom that pre-service teachers may need to address during their real classroom professional experience. The role-plays were created after a focus group meeting with current and past teachers to establish common classroom teaching scenarios. The system is designed with three major formative features: personal ejournals, peer and educator assessment and reflective opportunities. Pre-service teachers reflected on virtual world and real professional experiences in an ejournal to be shared with their educator. After the virtual world role-plays, pre-service teachers were asked to reflect on their feelings/perceptions of the role-play, discussing what worked, what didn't and how the workshops could be improved which were recorded. Feedback suggested that the role-plays should be conducted with off-campus students to provide authentic learning, as this is a method these students use to receive their learning. Finally, machinima (in-world video, see http://virtualprex.com/machinima.html) have been created to be used as formative and summative assessment. Pre-service teachers can view the machimina to discuss how the lessons could be improved.

Methodology

Overall, mixed-methods were used to gain a deeper understanding of how virtual worlds enhance assessment. For projects on University of Hamburg and Australis 4 Learning Second Life Islands, qualitative feedback was collected through inspection of the process – mainly observing how students performed group work and

challenged problems that occurred, including interviews at several stages of the project duration. Over a period of three years, we performed a qualitative benchmark of virtual worlds for assessing the outcome in projects by comparing preliminary expectations to interviews afterwards. The interviewees were asked to compare their experience to other projects they were enrolled in before. Due to a relative small number of students per semester (< 20 in the fields of computer science, information systems and psychology) and the large variety of projects, we did not pursue quantitative experiments. The overall feedback was used to adjust subsequent projects based on the knowledge gained about problem and risk areas as well as highlights to improve the experience.

VirtualPREX is in the early stages of data collection. First year pre-service teachers have undertaken a role-play testing the virtual world environment. Role-play lessons required students to act as either a teacher or primary school student, swapping their role between teacher/student or as a "good" or "naughty" student. At the completion of their role-play, pre-service students completed a survey collecting both quantitative and qualitative data on their experiences of using a virtual world and their perception of the role-play to assist with their PREX. Questions were also asked of their experience of technology prior to commencing their studies. Discussions were also held (and recorded) reflecting on the pre-service teacher's perceptions of their activity. They then undertook professional experience in a real classroom and have since completed a further survey to discover whether they felt that their role-play lessons assisted them in their real PREX. During this time pre-service teachers kept an ejournal to record their reflections of their activities, both virtual and real.

Case study analyses

University of Hamburg – UHH – Analysis of student participation and success in their studies

Virtual worlds were approached with high expectations on students' projects. That is, the upcoming lack of interest in programming among Information Systems and Business Administration students had been anticipated. Virtual worlds were mainly chosen as they allow for advanced results even without deep knowledge in programming, while students still require software development and programming skills and learn about the concepts. Besides general feedback about the unrestricted and collaborative environment, the following quote shows the success of using virtual worlds:

I enjoyed it. Compared to Java, it is much easier to implement the user interface using prims. The object-oriented concept is easy to understand, if real objects are used. All I had to do was implement some functions to have my objects communicate with each other and react on input by avatars.

The in-world projects turned out to be far more successful. Students reported that the open access, simultaneous collaboration and expressiveness motivated them. For the supervisor of the projects the 'anytime' access allowed for a continuous monitoring and intervention in case of deviation from the plan. The assessment allowed the inclusion of further aspects as feedback from external resources (visitors, international reviewer), team work, social skills and application of tools could be observed and evaluated without extensive effort.

Curtin – Analysis of Automated Assessment Lab business processes

In building the software artefacts to model the AAL business processes associated with automated assignment assessment and feedback provision, students kept a 'development journal' in which aims, expected outcomes, actual outcomes and personal reflections of each of the tasks associated with such an enterprise were recorded.

Typical tasks modelled included 'the assignment box' which was endowed with intelligence to accept assignments only in accordance with given parameters such as 'before due date/time', 'submitted and authored by qualified student', and 'correct format'. There are many such processes which are normally in need of 'human' attention but which can be readily automated in a digital environment. Students responded positively to the demands of writing program code in the Linden Scripting Language (LSL) and to the new environment for software development as exemplified by the following comments:

> Working in 3D was an amazing experience. The project gives students the freedom of creativity which allows them to innovate. In addition, the project requires students to exploit the knowledge they have acquired during their course. This includes project management, database, programming, communication and other relevant skills; and
>
> The project encompasses a steep learning curve in respect to creating artefacts in Second Life, scripting the objects using LSL and also navigating around Second Life.

In addition to the primary business functions, there was some supportive secondary functionality required. All users of virtual world technology experienced the steep learning curve referred to above, some of which relates to simply moving about with avatars. In this case avatar movement is not of primary importance and therefore some 'super-movement' devices were created, such as a '3D-lift' or generalised transporter module with inbuilt security features. This prompted the following reflections:

> *I really like the freeform structure, that is, that you give us a goal and we have to think of and implement our own solution. I enjoy this as most units in university I feel that I'm being led too much through the assessments and coming up with and creating my own ideas is quite enjoyable.*
>
> *It is the most attractive unit in my uni life. Everything in this unit is fresh, it is not only study, but also have a lot of fun. Using a game to teach student how to manage a project well, how to be creative, how to be successful. It not just game, it can be connected with the real life. I really think that will help me a lot in my future life; and*
>
> *All in all I think it was interesting and in a sense informative as it forced me to think outside the box and confines of what I was used to.*

Reflections, comments and appraisals such as those above are indicative of the invigorating and exciting approach and the motivation which is relatively easily achieved within a digital ecosystem 3D virtual world. Naturally, not all comments are positive. In the "not so good" reflection category was:

> *Sometimes the game speed is very slow in the uni, the 1700mb Internet usage is still not enough for the student who use computer in uni frequently. Moreover, because it is the first time I play the Second Life, I hope the lecturer could provide more resources for us if possible.*

indicating that one must always be mindful of the technological demands such educational interventions, or 'adventures' as we prefer to think of them, require to be met so as to produce as stress free and supportive environment as possible.

Whilst the particular projects were deeply immersed in technology, students were able to take a broader perspective as seen in the following reflection:

> *It's a great experiment. SL brings possibilities to learn, have fun and practice at the same time. The good thing is: this unit is good for my future career.*

UNE (VirtualPREX) – analysis of teacher/student role-plays in Second Life

At the time of publishing, only data from the Pilot survey had been collected. The survey was conducted immediately after the completion of the VirtualPREX role-play activity. There were 72 responses to the first survey. The survey asked demographic questions and queried pre-service teacher's knowledge of virtual worlds prior to their workshop and their thoughts and feelings of the workshop. In Table 1 are the results where pre-service teachers were asked to rate the importance of the learning benefits of virtual worlds. The results indicate that students were close to the middle (3.5) with all responses. Ratings were 7 being "extremely" and 1 being "not at all" to the words describing the learning benefits; confusing, difficult, irrelevant, interesting, easy to use, useful, boring, enjoyable. The areas which had the higher (more extreme) responses were that the pre-service teachers found undertaking teaching/student role-play activities interesting, easy to use, enjoyable and useful. The negative indicators (confusing, difficult, irrelevant, boring) received lower responses, indicating the activity was worthwhile, from the pre-service teacher point of view. (More analysis of the data can be found in Gregory, et al., 2011)

Table 1: VirtualPREX – Overall rating of virtual worlds role-play activity

					1=Not at all — 7=Extremely (n=72)		
Confusing	Difficult	Irrelevant	Interesting	Easy to use	Useful	Boring	Enjoyable
3.75	3.41	3.26	4.77	4.47	4.08	3.49	4.44

Pre-service teachers were asked to rate how often they used various elearning tools prior to commencement of their studies. The results indicated that pre-service teachers used the Internet (97%), Facebook (81%) and Smartphones (42%) on a daily basis, but almost never used networked games such as World of Warcraft (3%) or virtual worlds, such as Second Life (0%). This also demonstrates that the pre-service teachers had a significant

amount of learning to be able to use the virtual world for their role-play. Figure 1 provides a visual overview of pre-service teacher usage of various learning tools prior to commencing their studies at UNE.
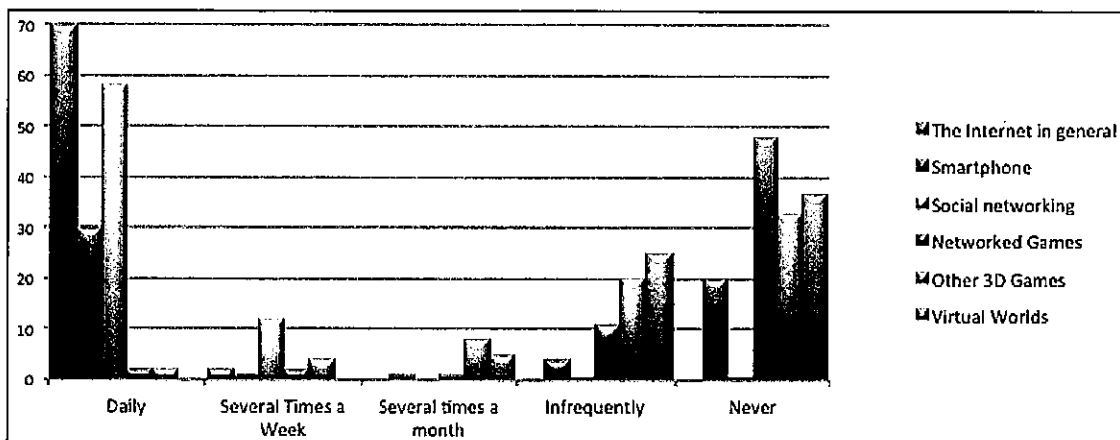

Figure 1: eLearning Tool Usage

After pre-service teachers had completed their role-play activities, a further question in the survey asked students to rate the importance learning benefits of virtual worlds. These were:

    a)   They can assist learners in developing familiarity with a place and the objects within it;

    b)   They can be motivating and engaging for learners;

    c)   They can lead to improved transfer of learning to real situations;

    d)   They can enable more effective collaborative learning;

    e)   They can allow learners to learn through experience in context.

Pre-service teachers rated these according to their importance with "Extremely Unimportant" being the lowest and "Extremely Important" being the highest. Figure 2 signifies that the pre-service teachers were all in the range from "Neutral" to "Very Important" with very few rating below "Neutral" or above "Very Important". This indicates that, overall, the pre-service teachers valued their learning and experiences in their role-play of VirtualPREX.
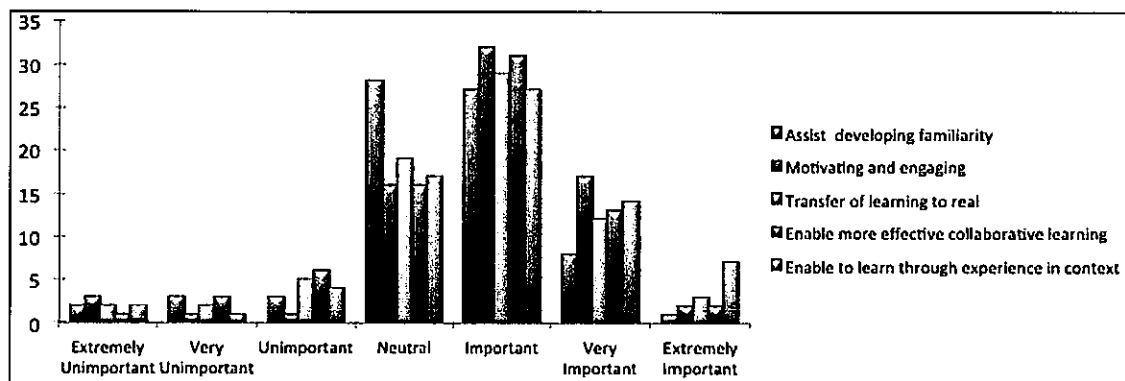

Figure 2: Importance of learning benefits of virtual worlds

To provide the reader with a context of the virtual classroom, Figure 3 provides images of classes in action and demonstrates methods the teachers undertook to engage their class in their lesson. Students began sitting at their tables (as depicted in the first image) and then were provided with roles to act out. The first image shows students at their desks, one wandering around the classroom and another standing in front of the teacher. The second image demonstrates the teacher using strategies to engage all students in their class. This teacher requested students to go to the front of the classroom and undertake a dance lesson. This gave the 'wandering' students a task that they wanted to particpate in.
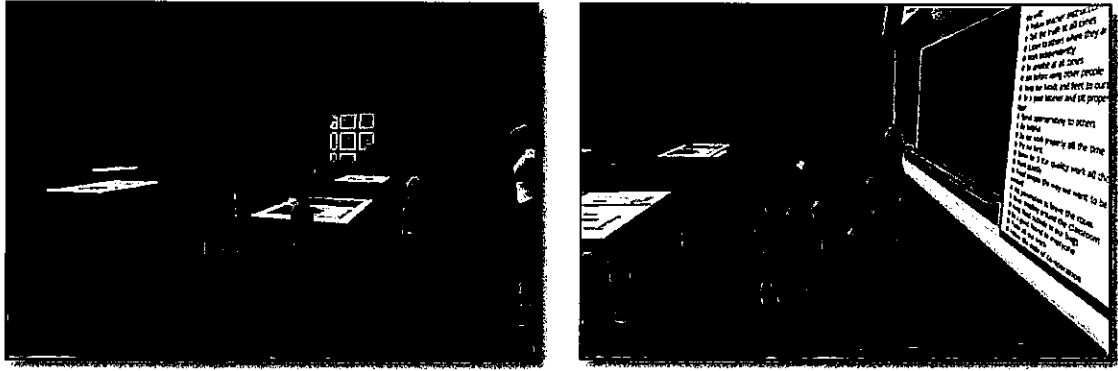
Figure 3: Pre-service teachers undertaking VirtualPREX role-play activities

Future and conclusions

Assessment in a real classroom is well documented but in a virtual world, educators are still gathering knowledge on how to ensure that authentic learning and assessment tasks take place. The ideas and experiences presented in this report demonstrate that there are authentic assessment tasks being undertaken in the three cases however, it is not part of mainstream education practices at this time.

The advantages of assessment in a virtual world are that students are provided with the opportunity for authentic assessment tasks in settings that are scripted and adapted to the user. Students are also able to undertake peer and self-assessment in realistic scenarios. Our outcomes demonstrate the importance for role-play that requires effort and a number of people to do so in reality. For some people they would feel uncomfortable role-playing, such as the workplace harassment scenario, but in a virtual world it is easier in a neutral, safe and potentially anonymous capacity. Also, in a virtual world, people can undertake role-play practice with bots to automate this procedure.

The assessment rubric used in real classroom situations is, again, well documented. However, in a virtual world, the use of a rubric is in a preliminary stage and this has implications as to the authenticity of the assessment tasks. There are no clear guidelines established as yet. Further exploration of assessment in a digital ecosystem, for example, Second Life, will inform educators interested in realising the potential beneficial and superior learning outcomes for their students.

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