Developing an evaluation methodology for immersive learning experiences in a virtual world

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Abstract. This article proposes an evaluation methodology for supporting the development of specified learning activities in virtual worlds, based upon inductive methods and augmented by the four dimensional framework [4]. The study undertaken aimed to test the efficacy of the evaluation methodology and to evaluate the broader uses of Second Life for supporting lifelong learners in their educational choices and career decisions. The paper presents the findings of the study and argues that virtual worlds are reorganising how we relate to the design and delivery of learning. This is opening up a transition in learning predicated upon the notion of learning as made up of immersive experiences rather than sets of knowledge to be transferred between tutor and learner. The challenge for tutors remains in the design and delivery of these activities and experience and the approach advocated here builds upon an incremental testing and evaluation of virtual world learning experiences.

Keywords. Evaluation methodologies, virtual worlds, serious games

I. BACKGROUND

The wide reporting of Second Life has helped to highlight the wider use of immersive worlds for supporting a range of human activities and interactions, presenting a wealth of new opportunities for enriching how we learn, how we work and how we play (e.g. [1]). In this way, Second Life, in common with other virtual world applications, has opened up the potential for users and learners, teachers and trainers, policy makers and decision-makers to easily collaborate together in immersive 3D environments. Through the presence of the user as an avatar in the immersive space, the user can readily feel a sense of control within the immersive environments and more easily engage with the experiences as they unfold. The use of virtual environments has been facilitated greatly through web-based applications that allow us a range of options including sharing documents and files, holding meetings and events, networking and hosting virtual seminars and lectures, running research experiments and providing forums for sharing research findings and meeting international colleagues. Such applications also have an even greater potential for integrating different technologies by supporting social software applications, presenting e-learning materials and content and offering users games and narrative-based social interactions.

However, in previous work it was identified that there were a great range of different virtual world applications, and in work preparing this article 80 virtual world applications were identified with another 100 planned for 2009. The extent of the field, not just in terms of potential use for education and training, but actual usage and uptake by users is extensive and Second Life currently has 13 million registered accounts (as of March 2008). This article however is focused upon how virtual worlds can be better understood and used in the context of education and training, and here the use of Second Life for supporting seminar activities and lectures and other educational purposes has been documented in a number of recent reports e.g. [3,12] list a wide range of examples of Second Life use by UK universities.

The breadth of applications of virtual worlds, and their relatively swift emergence, have made this a challenging area for researchers and tutors. The work being undertaken at the UK-based Serious Games Institute (SGI) has been exploring ways to utilise the technology, and has been attempting to develop methodologies, frameworks and metrics to allow tutors and other user groups to more readily engage with the virtual worlds. However, the area is fragmented and literature is dispersed around a range of disciplines, and this makes the field challenging for those involved within it. This study undertaken as part of the JISC-funded MyPlan project (www.lkl.ac.uk/research/myplan) led by the London Knowledge Lab (www.lkl.ac.uk) is seeking to develop a set of methodologies and perspectives that may allow for greater cross-disciplinary engagement, but this process needs to be collaborative, taking on board a range of disciplinary methods and perspectives.

Underpinning this approach towards producing cross-disciplinary approaches to the emerging field of serious games and virtual worlds, the SGI has been

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attempting to reconceptualise ideas around learning, in particular away from more traditional approaches to learning and towards a notion of learning as more centred upon experience and exploration. This approach reorganises how we produce and develop learning activities, with a greater emphasis upon learner control, greater engagement, learner generated content and peer-supported communities. Work outlining an exploratory learning model is outlined elsewhere [6], and this paper aims to present the outcomes from a study undertaken to evaluate the efficacy of using Second Life as a platform for supporting lifelong learners from two user groups. The study was testing the four dimensional framework developed in previous studies, and outlined in [4].

II. METHODOLOGY

Few other evaluative frameworks for games and virtual worlds have been proposed [9]. Therefore this evaluation study adopted an inductive methodology which requires researchers to construct theories and explanations based upon observations conducted using educational research approaches, including survey data and observations [10]. A similar approach has been adopted in the larger Serious Games – Engaging Training Solutions project co-funded by the Technology Strategy Board, Vega Group Ltd and TruSim (a division of Blitz Games), based upon measuring the efficacy of game-based learning [5,6]. The methodology was selected to address some of the wider issues of efficacy and to highlight some of the main issues arising from this form of learning and support.

The study also integrated the use of the four dimensional framework to provide a more structured approach to the synthesis and analysis of the research findings. The four dimensional framework has been proposed in previous studies and papers [4]. The framework emerged from user studies and was proposed to help with the evaluation of educational games. But it has since been used to support the game design and development process. In this study we pioneered its use for supporting other immersive experiences – in virtual worlds. The four dimensional framework proposes four dimensions: the learner, the pedagogic models used, the representation used and the context within which learning takes place. See Figure 1.

Four Dimensional Framework	
Learner Specifics	**Pedagogy**
Profile	Associative
Role	Cognitive
Competencies	Social/Situative
Representation	**Context**
Fidelity	Environment
Interactivity	Access to learning
Immersion	Supporting resources

Figure 1: The Four Dimensional Framework.

The first dimension involves a process of profiling and modelling the learner and their requirements. This profile ensures a close match between the learning activities and the required outcomes. The second dimension analyses the pedagogic perspective of the learning activities, and includes a consideration of the kinds of learning and teaching models adopted and the methods for supporting the learning processes. This may include the use of associative models based upon task centred approaches of learning and consistent with training methodology (e.g. Gagne), constructivist models of learning involve approaches that invoke building upon existing knowledge on the part of the learner (e.g. Vygotsky). Situative models of learning involve more socially constructed approaches to learning (e.g. Wenger's model of communities of practice). Particular selection of learning theories can prefigure the types of learning outcomes that result. For example, immersive experiences based upon task centred analysis and learning task construction will result in task centred outputs and although effective may be limited. Also, certain forms may reinforce particular approaches more readily. The third dimension outlines the representation itself, how interactive the learning experience needs to be, what levels of fidelity are required, and how immersive the experience needs to be. The representational dimension includes the 'diegesis' or world of the experience, and may affect levels of engagement and motivation. The final dimension of the context, may impact upon the place where learning is undertaken, e.g. in school or informal contexts, it may also affect the disciplinary context e.g. which subject area is being studied, and whether the learning is conceptual or applied. Context may also include the supporting resources used for learning.

Together the four dimensions provide a conceptual framework for understanding immersive learning, and have implications upon learning design as a whole, particularly when applied to serious games and virtual

worlds. In part to test the efficacy of the framework and the methodology outlined, the study aimed to explore this framework. The findings of the study are synthesised in relation to these four dimensions. The study included user studies with two groups of learners: mature students studying at Birkbeck College on the IT Applications programme and college students from Hackney Community College studying on BTEC courses. The data collection methods included pre- and post- activity surveys, video observations of real world and the in-world sessions and chat logs.

III. THE STUDY

The Learning Day sessions were devised to produce structured activities functioning as focus group activities to highlight main issues arising from this mode of learning and to aid with producing guidelines for tutors using the tools. In terms of the learning required, the activities were designed to support learners increasing their knowledge of virtual worlds and to support their career choices by introducing them to experts in ICT. The sessions were held in two computer labs at the host institutions Birkbeck College (BBK) and Hackney Community College (HCC), and in Second Life. Student groups from both institutions were selected for the study. The students from Birkbeck's IT Applications programme were mature part-time students all over 18 years of age, and were self-motivated learners. The students from Hackney Community College were aged between 18-24 years and were studying for BTEC courses. The two groups offered a good counterpoint for the study, allowing the researchers to test a range of different responses to the learning activities under exploration.

Although the intention was that each learner had access to the Internet, some students' sessions at HCC were shared since not enough computers were available. User groups consisted of seven students at BBK and fourteen at HCC. A tutor with experience of Second Life guided the sessions which lasted between 2-3 hours. At the beginning and end of both sessions individual students were asked to answer an online survey.

Although factors outside our control altered the sessions (see below), they aimed to take the following structure:

- Introduction to the session. The tutor introduced the session, explaining the timetable and answering any questions from the learners.
- Introduction to Second Life. The tutor takes the students through the induction into Second Life: creation of an avatar, induction session in how to use Second Life
- Learning Day sessions (blended approach with face-to-face and virtual sessions). The tutor and learners visit the UCAS Second Life island. Each learner has a session with a UCAS advisor in Second Life. The second stop is to the SGI in Second Life. Here there is an e-lecture from an IT professional with slides discussing the merits of an IT career. There is also a short session with David Burden, an expert in Second Life who discusses the merits of using SL. The group then go to the IBM island where they walk around and meet an expert.
- Debrief session. The tutor holds a debrief with the group, including a discussion about their experience and completion of survey.

A. The Learner Dimension

A total of 18 students answered the pre-activity survey, 7 (38.89%) were BBK students and 11 (61.11%) were from HCC. The average for self-rated ICT skills (using a scale from 1-5, where 1=not very good and 5=excellent) was 3.94 where BBK students' skill was rated as 3.57 and HCC students' skill was 4.18.

66.67% of students do play video games (28.57% from BBK and 90.91% from HCC) of which 70% from HCC play every day. Video games are played once a week by 50% of BBK students and 10% of HCC students. 2 to 5 times a week by 20% of HCC students and once a month by 50% of BBK students who play video games.

The students who play video games answered that online games were the most popular (40% from HCC and 100% from BBK), followed by PC (30% from HCC) and console (30% from HCC and 50% from BBK). Other forms of video games that are played are mobile games by 20% of HCC students and virtual games by 10% of students.

Only 22.22% of the sample had used virtual worlds before. Broken down by institution 28.57% of BBK students and 18.18% of HCC students had used this type of application before. All of the students who had used virtual worlds previously had chosen Second Life, and none had used a different platform such as Olive. All of the students had used Second Life only once.

A total of 16 students answered the post-activity survey, 2 students from HCC left after the session without having completed the survey. All 7 students from BBK and 9 from HCC completed this survey. When asked how much they had enjoyed the Second Life session (using a scale from 1-5, where 1=didn't

enjoy the session and 5=really enjoyed the session), BBK students averaged 3.14 while HCC students 3.22.

The survey asked students about enjoying different aspects of sessions using the same scale as before:

TABLE I. TABLE 1: AVERAGE OF STUDENTS' ANSWERS IN THE POST-ACTIVITY SURVEY

Aspect of session	BBK students	HCC students
The face-to-face sessions	3	2.5
Using the SL application	3.14	2.66
Creating avatars	2.2	3.14
Moving in the virtual space	2.42	2.75
The visit to UCAS island	2.83	3.125
The SGI presentations	3	3.125
The visit to IBM's island	2.85	3
Meeting the experts	3.14	2.87
Reacting with your fellow learners in-world	3.5	3.14

43.75% of the sample (42.88% from BBK and 44.44% from HCC) would recommend the use of Second Life to their friends. When asked whether Second Life sessions helped them to reflect upon your educational choices and career decisions only 12.5% of the sample answered positively (14.29% from BBK and 11.11% from HCC). However, when asked whether they would like to use Second Life or another virtual world as part of an educational environment for international collaboration with students globally the majority of the sample 81.25% answered affirmatively (100% from BBK and 66.67% from HCC).

B. The pedagogic dimension

The pedagogic dimension of the study design rested largely upon a constructivist model where knowledge construction on the part of the learner was inferred. It was expected that the learners' experience would build upon previous experiences in particular building upon previous experience of similar formats of learning and previous knowledge of career decisions and educational choices. However, this area of the study design perhaps inferred to much prior knowledge on the part of the learner and some learners found it difficult to engage with the virtual world. A more structured pedagogic model and more structured activities in-world was perhaps needed.

Although a more constructivist approach was favoured for the study, the findings seemed to point to the tool with more strengths for social learning. One college student noted that: '[it] brings all people from every aspects of the world together and learn about each other [sic]'.

The emphasis and strength of the system for supporting social interactions was supported by the comment from one learner around use of voice capability. 'We couldn't use voice on this trial, but I'm sure this would help quite a bit.' However, in some studies with tutors they have expressed a preference for using text interactions. Other studies with Second Life have demonstrated similar findings to this study. In particular the study undertaken by Diane Carr observing the use of Second Life with Masters students at the Institute of Education as outlined on the Learning in Social Worlds project blog [1] demonstrated some similarities, such as problems with using text chat, disorientation and ambiguity, the need to spend time getting used to the interface and the complexity around structuring experiences that are useful for supporting learning. Carr summarises this:

> A great deal of 'structuring' was going on during the sessions – the tutors' frantically [sic] use of Instant Messenger, for instance, that was not visible to the students. Also, there were 2 or 3 tutors at each session, taking on different roles in relation to content and class management [2].

More research is needed to further target the best approaches to tutor-scaffolded virtual activities and this is an area for consideration for the next phase of research. The study also pointed to strengths of using Second Life in terms of enhancing social interactions, useful for distance learners and adding a greater sense of presence than traditional virtual learning environments such as Blackboard, with which the use of Second Life was compared (rather than face-to-face learning). Carr's study also found that some students were unable to adapt to the use of virtual worlds.

C. The representational dimension

In this study the main area of data that emerged relating to the representational dimension concerned the usability of Second Life. There were clearly issues with the technology, not least because there were significant problems with connectivity and local development work going on at Linden Labs that affected the access to the system. These technical issues had a clear impact upon negative transfer of the learning experience.

The comments from students underlined these technical issues. With respect to the usability of the system, learners commented that 'movement was a bit sluggish, but I suppose that's more to do with the internet connection I think.' One of the college students noted: 'make it so it dont [sic] glitch as much

[1] For full report of the EduServe-funded Learning in Social Worlds study see: http://learningfromsocialworlds.wordpress.com/learning-to-teach-in-second-life/. Last retrieved online on 20th August 2008.

and add a few more features to the island'. Although at least one of the mature students could see real benefits for those with disabilities:

> I work with drama/theatre and people with a disability - acquired brain injury - who are on a programme getting them back to work. I think there are some really interesting possibilities in helping to develop confidence among such clients interacting virtually before or as an adjunct to 'real' life social interaction and skills development. Mature student.

As one would have thought the connectivity problems were significant and led to some comments from the learners, such as: 'a better internet connection would have allowed us to have a "fuller" experience. I think that would have made it better'. But the findings were considerably more negative from the students as a result of the connectivity and technical issues. The issues are significant and tutors aiming to use Second Life would have to find coping mechanisms for these kinds of problems that occur with limited broadband, accessibility issues and regular maintenance work at Linden Lab. The newness of the technologies and the architectural issues with Second Life have led a group of open source developers to develop OpenSim. The aim is to develop a more scalable architecture and to allow the application to be held behind institutional firewalls.

D. Contextual dimension

The students were participating in a study situated at college and university, and as such the context of learning was strictly formal. It would be interesting to gauge the reactions if the study were undertaken in informal learning settings, at home, or in work based settings.

There were wider contextual issues that affected the efficacy of the learning experiences and these centred upon a lack of engagement with the virtual worlds due in part to specific learners' background and age, at least in part. For example, one or two students did have problems relating to the format: one mature student for example commented: 'I am afraid that I cannot relate to the virtual world'. Another student commented that 'I think anyone new to SL would need someone to show them how to use it, as it is not intuitive to non computer games players.' The mature student commented that 'my worry is that it would exclude people who weren't technologically sophisticated.' They felt that: 'I can't relate to a virtual world and imaginary people; it makes me restless and want to be with real people.' Interestingly this student found it difficult to relate to the fact that avatars were all human driven, and felt distanced from the real people due to the interface and use of avatars. This was compounded by the fact that the student was not familiar with the process of text chat and found it alienating for communicating with others.

The study threw up particular issues around accessibility including the quality of broadband connectivity and usability including the user interface design, as noted. These issues are in need of deeper consideration in follow up studies. It is undeniable that using Second Life behind the institutional firewalls is a difficult and imprecise undertaking, and negative first impressions can be off putting to the extent that some will not return. Linden Lab estimate that half of all users never return after their first hour in Second Life [13]. However for those that do there are interesting applications that can be investigated [3,7].

IV. Discussion

HCC students self-rated their ICT skills considerably higher than BBK students. This may be attributed to the difference in age groups: HCC students were all college students between 18-24 whereas BBK were mature students.

It seems the most popular choice of video game are online games (100% of gamers at BBK and 40% from HCC), but other forms of gaming such as consoles and PC-based games are also popular. HCC students are heavy gamers but only a few (18.18%) had seen or experienced a virtual world. This is partly attributable to the comparatively higher numbers of users using multiplayer online game when compared to virtual worlds. While multiplayer games may have educational potential in the future, however, virtual worlds are generally regarded as having greater educational potential currently due to their more open-ended nature. The convergence between games technologies and educational uses is occurring in the shape of serious games and simulations, but as this study has shown there is still a learning curve to overcome when using virtual world applications to support learning. Game experience may in fact have a negative impact upon learning with virtual world applications, as game-players are used to much higher levels of fidelity and interactivity than are presently available in virtual worlds such as Second Life.

In contrast with other studies, the least liked aspects of the interaction in Second Life were creating avatars and moving in-world. This was certainly due to extremely slow connections as a result of maintenance work that day at HCC and due to multiple users on the network at BBK, both of which caused slow download times. In general the research indicates that control over avatars can be a critical aspect of allowing users to become engaged and motivated through empowerment of controlling their own representation

in-world. Although work by Diane Carr for example has indicated that for some learners this can be off putting and produce a 'pain barrier' to be overcome . From our study it was clear that the college students felt more familiar with the process of avatar creation and that this held their attention.

The research team found real challenges with assessing the efficacy of Second Life for supporting educational choices and career decisions, in terms of the structuring of exercises, providing the best support for the students and also in terms of technical issues. While some students were engaged with the tool more work is needed to find out ways of engaging more students with how to structure the activities, and greater support in advance of trialling is required. More rigorous frameworks and metrics would also be useful for supporting future efficacy studies. The research team would like to undertake further studies towards that end. Reflecting on these difficulties, only a handful of students (12.5% of students) said Second Life helped them to reflect upon their educational choices and career decisions. This indicates that the platform is one which in the structured format used with users would not be appropriate for mentoring students. In particular the technical issues such as accessibility and usability were too jarring for the students, and got in the way of them appreciating the value of the form. Problems with Second Life were connection speed, difficulty to move around, orientation, lack of signposts, and not using voice as in a classroom setting impeded the study. The HCC did visit the UCAS island, but needed more support with their interactions with the information there. They also thought more signposting on the island would be helpful. They enjoyed visiting the IBM island but also needed more support and guidance in-world. Due to technical issues it was not possible to provide this.

On the other hand, 81.25% of students saw Second Life as part of an educational environment for international collaboration with students globally. This indicates that there are other aspects of Second Life that may be used in the future for supporting MyPlan and other learning activities designed for lifelong learners.

The social dimension of Second Life is undeniably a powerful component of the format, and when the technology becomes more stable, and broadband can be guaranteed within institutions then it could be used for role play, mentoring and for social skills acquisition. Other academic institutions in the UK are finding positive outcomes from studies using Second Life (e.g. Kirriemuir, 2008).

The issues of accessibility were highlighted by the users; one argued that users needed to have a good understanding of technology to gain the most from Second Life. While the entry requirements for accessing Second Life are relatively low, to maximise your enjoyment good connectivity speeds are essential. At present most institutions do have issues with firewalls and broadband to compete with and these can be prohibitive.

There were usability issues with Second Life and other virtual worlds beyond the connectivity issues highlighted by the participants of the study. In this study the connectivity impeded full usability of the system, and beyond this users would need to familiarise themselves with the software in advance of holding sessions to get used to the interface.

In summary, the use of Second Life for supporting learning needs is problematic while accessibility and usability issues remain. The use of the system for supporting mentoring has not been fully proven, although using the system as a social component to the system or for creating links with global groups of students needs to be more fully explored in later studies supporting the system.

The main lessons arising from this study demonstrated a need to evaluate the platform with a larger sample of students. In addition there was a need to design more structured activities, for better orientation for learners and tutors in advance of the study and a more concerted technical support and resource.

It was found that the inductive methodology of data collection was effective for providing information about the use of Second Life; in particular the combination of chat logs, video footage and surveys was useful for providing a more multidimensional impression of the usage of Second Life. The use of in-depth semi-structured interviews with some of the participants would have been useful.

A follow-up study that examines the design, development and use of virtual worlds for tertiary education with lifelong learners would be desirable. A large-scale study using larger numbers of users exploring the patterns of use of modules being taught in Second Life in particular with a comparison between face-to-face learner groups and distance or online learners would be useful.

Additional tools for using Second Life for education might be useful, for example developing scenario-editing tools in-world. These integrated tools (including the MyPlan tools) may be used to support lifelong learning communities or be used in a targeted way to

support social interchanges within specific research and educational communities.

The use of immersive learning is prefigured by a shift from considering and designing learning tasks to learning experiences. This shift merits consideration of learning experiences as involving social interactions between members of the learning group, individual pathways and methods of tutoring that focus more upon mentoring and guiding development. Towards this end, tutors may analyse the learner group and consider their ICT skills levels, game experience and learning approaches. Also, they may consider the pedagogic approaches needed for the subject area taught, learner group and context of learning. Use the four dimensional framework can support this process [4]. Tutors may produce a learning activity schedule with main learning outcomes identified and an analysis of the ways in which Second Life could support learning objectives.

Orientation is important for new users of virtual worlds to induct them into using the platform, and for maximising their engagement with virtual worlds as a whole. As this study has demonstrated, those who are used to gaming and who use multi-player games regularly often find the unstructured and open-ended aspect of Second Life difficult to adapt to. They are used to structured activities and it can take a long while for them to adapt to these more exploratory worlds. To support students who are novices and regular game players, it is useful to hold start-up sessions with students in advance of learning sessions to allow students to become orientated with the interface. For example, sessions could be held where students log in from home, allowing sufficient time for them to become used to the interface.

V. Conclusions

The use of the evaluation methodology allowed the research team to evaluate the learning experience according to set criteria. The evaluation methodology may be used as a design tool for designing learning activities in-world as well as for evaluating the efficacy of experiences. The approach does augment the existing methods for evaluation, but needs to be tested with a larger sample and in wider contexts of use to verify its efficacy across different platforms. The research group at the SGI will continue to trial the framework in future studies with users of immersive experiences.

While the benefits of using Second Life are in this study outweighed by the technical issues that arose during the sessions, some benefits of using Second Life for supporting under-served learners, for engaging learners, and for supporting distributed groups of learners were highlighted. While with the advent of OpenSim and other virtual worlds many of the technical issues will be overcome, it is recognised that such tools are still relatively new and that more work needs to be undertaken to establish their effectiveness, to produce clear guidelines and to exploit the capabilities to the highest degree.

In particular, the students were positive about using the tools for supporting international collaboration, indicating the power of the tool for supporting distributed communities based upon shared interests. While the study has not proved conclusively the power of the tool for mentoring, the sessions with the mentor were very effective in practice, and in the future one-to-one sessions with mentors based abroad or not co-located could be further explored. The tool would also support peer collaboration and could be used for example for collaborative assignments in-world with practical outputs, for example designing a marketing campaign in-world. The use of such a format for supporting international students and distance learners could also be a key area for future development supplementing face-to-face learning. Also, there is real potential for supporting online learning methods by extending the benefits of audiographic conferencing to provide a greater sense of presence, thereby reducing non-completion rates.

For the user groups that were tested in this study, the benefits were limited by the technical problems experienced. Although many of the students did in fact enjoy the experience, future testing sessions would be structured differently, and have more targeted learning outcomes focusing upon bringing different groups of learners together, and online lectures and assignments would be included in the sessions. To overcome the issues of broadband, sessions may be held after hours from students' own home connections, allowing them to use voice facility and allowing for faster speeds. In the future, studies may be undertaken using OpenSim to ameliorate some of the technical problems experienced with this study.

The potential of using Second Life for supporting life decisions and educational choices is clear, but thorough testing of sessions, appropriate technical support and well-structured sessions are essential for providing enriched experiences. In particular, this approach would work well with distance and online learners, or as an additional support for face-to-face learners. The use of virtual worlds may also need to be considered in relation to other media support mechanisms, such as videoconferencing and virtual learning environments, which may help to support the community-based and collaborative strengths of immersive environments. This study also indicated

strengths for supporting particular user groups involved with career and educational choices, in particular distributed user groups.

We consider that virtual worlds such as Second Life are useful for supporting this type of activity (i.e. helping students to make life decisions) by offering experiences, for example, of the type of life students can have if they follow a particular path, though mentoring, and through specially designed learning activities in-world. However this is dependent upon how the in-world activities are designed and the quality of social interactions experienced. These need to be not only engaging for focusing the attention of learners and decision-makers but also based upon pedagogical principles. This is an area of research that needs further exploration as these activities differ from typical academic ones in that they are not intended for learning but for taking decisions.

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