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Using student voice in the design of game-based learning

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Game technologies can provide exciting ways to engage and educate students and provide an active learning experience with a goal-directed agency. This research investigates how student voice is integral to the development and trialing of educational computer games in order to effectively target, and add meaning and relevance to learning outcomes. Games can offer a transformational change in pedagogical approaches by being intrinsically motivating, providing immediate feedback and scaffolding skill and knowledge acquisition. The research focused on understanding learner needs by involving students in project based development and examines the rationale behind making a pedagogical shift from unidirectional content delivery to collaboratively designing experience. The study adopted a Design Based Research methodology, within an Activity Theoretical framework.

Keywords: Activity theory; Game-based learning; virtual worlds; student voice

Introduction

The research explored the design, development and trial of computer games used for learning and teaching, and investigated the significance and impact of game parameters on learning outcomes in the Vocational Education and Training (VET) context. The games-based learning environments involved interactions amongst students, VET teachers and game developers. Three games were designed and developed for the research addressing different VET disciplines and curriculum, and trialled with different cohorts in order to listen to the voices and experiences of a diversity of students (Beavis, Muspratt, & Thompson, 2015).

These games included: *Play It Safe* which addressed three Units of Competency at Certificate and Diploma level from MEM05: Metal and Engineering Training Package; *LabSafe* which addressed one Unit of Competency at Certificate and Diploma level from PML04 - Laboratory Operations Training Package; and *The White Card Game* which addressed one Unit of Competency at Certificate level from CPC08 - Construction, Plumbing and Services Training Package. The iterative development of the three games allowed for the student voice to play an integral part in improvements in the pedagogical alignment and design.

Research design and methodology

The research design has been structured around clearly defined phases. The research progressed in iterative cycles with each successive phase of data collection and analysis informing modifications to the games. The iterative development of the three games allowed for student voice to be an integral aspect for the improvement in the pedagogical alignment and design by providing insight into students' learning experiences (Campbell, Beasley, Eland, & Rumpus, 2007)

The major concern that guided the research design of this project were the significant resources and time required for designing, developing and refining computer games to be used for education. The aim was to explore an approach to analyse tensions and facilitate productive interactions among developers, teachers and students that are involved in the design, application and use of games-based learning. The approach adopted an Activity Theoretical framework in order to analyse needs, tasks and outcomes in the games-based learning environment. In particular, how to best target skill development and knowledge acquisition by involving students in the iterative cycles of development of these highly interactive learning environments. This approach involved: analysing the interactions between components in the games-based learning activity system while they evolved; identifying contradictions and exploring the mediation that progressed the activity outcome; and examining game components within the games-based learning context. This analysis was facilitated through data collection from students that focused on (Seale, 2009):

- asking questions about their experience;
- observing and understanding the student learning perspective;
- reflecting on implications of design choices; and
- catering to the diverse needs of the student cohort.

The components of the activity system that were examined included narrative, gameplay and fun. The data analysis revealed significant increases in knowledge transfer, skill development and engagement with the curriculum in comparison to conventional pedagogical approaches. Data included observations, surveys, interviews collected during the design, development and trialing of three 3D first-person shooter learning games.

Each VET game developed was designed as a discrete activity system. Data was collected from each system and comparative analysis of the components undertaken. The data was analysed in the context of Activity Theory and Design Based Research. By gaining insight into the impact that the components have in different activity systems we can understand the interaction of the components and hence how they influence the learning outcomes, or developmental transformations of the system. The activity-focused data collection and subsequent analysis paid attention to:

- Learner's activities – how the game structure facilitated or constrained successful learning outcomes;
- The game environment – the design of the game including narrative elements and gameplay;
- The dynamics of interaction – interaction with learning content; and
- Developmental transformation of the complete system.

Activity Theory describes how the effectiveness of learning systems depends on the interplay of subjects and objects (Figure 1) (Engestrom, 1987). The focus of activity system analysis involves a subject, the object of the activity, the instruments that are used in the activity and the actions and operations that affect the outcome (Jonassen & Rohrer-Murphy, 1999).

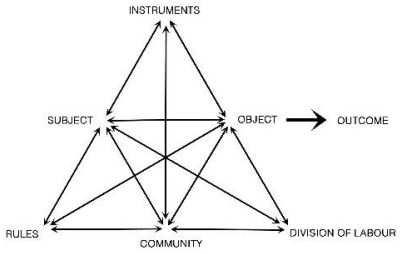

Figure 1. Engestrom's Activity System Model

In the games-based learning context of this research, the learner has been designated 'the subject' engaged in the learning activity, the 'object' of production is the trial of the game and the 'outcome' is the knowledge gained from the activity. The activity can be analysed by examining the tools/devices that mediate it, and the tools can only be understood by the context in which they are used. This context includes cultural factors such as rules, the community and the division of labour. When applied to a games-based learning environment, rules can be interpreted as the 'control' of learning that is dependent on students, teachers and their interaction with technology. Community encompasses styles and strategies of learning and interaction with the technology. Division of labour can refer to communication in that learners adopt new forms of communication when they become available (Sharples, Taylor, & Vavoula, 2010).

The iterative development of the games trialled in this research was in response to the learning context, with each modification a result of feedback from students, VET teachers and developers, which was subsequently assessed, discussed and implemented into production. Although the learner's experience in playing the game could be perceived as achieving individual goals through a series of game tasks, the activity is a system of social relations. This learning is taking place through a complex collaboration of institutional, team-based and artificial agent driven activity – a 'system of collaborative human practice' (Engestrom, 1987). The Activity System is continually transforming through the interaction of components in a dynamic system and represents the processes of learning (Kaptelinin & Cole, 2002).

Results and discussion

The results of this research indicate that student voice is critical for improving curriculum design in games-based learning environments. Observations and interviews with students undertaking trials of the games during iterative development cycles, and surveys and interviews of students after playing the final version of the games are presented along with the analysis of how student voice has impacted on learning outcomes.

Gameplay and learner agency

In the surveys, 83% of the respondents agreed or strongly agreed that they learnt about the topic playing the game. Student comments from interviews indicated that the gameplay experience was relevant and contextualised to the practical work-based situations they were training for:

> So much easier to learn the basics when you play the game because it gets you involved in what is happening around you, which makes you pick up things much faster.
>
> The game was like the real workplace.
>
> Hazards were in the right places just like a worksite, and dealing with them too.
>
> As far as from an apprentice point of view it works really well, considering when I was a first year apprentice you don't really give a damn, until you do some nasty stuff to yourself.

The student learning narrative

The game world enables players to make choices that advance the game narrative. This was supported by 84% of students agreeing or strongly agreeing that they became more involved in the game as the game progressed. The game allows students to have a voice in deciding their own destiny, and hence learning, in the game environment. The player as 'person with intentionality'(Barab, Gresalfi, & Ingram-Goble, 2010) makes choices in the game context which reveals consequences for players' decisions. Game-world dilemmas aligned with the learning content are resolved by player action. Student comments indicate that learning happens through resolving issues presented in the game narrative:

> Make sure you don't do things too quickly, skip process you end up getting hurt.
>
> You got consequences if you stuff up.
>
> Useful to do everything in sequence, like switching off gas and electricity in the fire emergency before leaving. These I cannot find in real life. When I have to do experiments, disposing of waste, when I finish experiments I have to dispose of waste properly, not just get the result of the experiment.
>
> You can't complete it unless you complete the tasks, you gotta walk through the workplace and find things – tools, shadow boards makes you look at things, so you know what to look for.

The narrative in the game is particularly relevant to a VET context where players are training to achieve vocational outcomes. Game players draw on culturally available narrative components to contextualise their actions (Louchart & Aylett, 2004). In the games trials, VET learners were able to draw on or refer to the vocational context, and in doing so were able to create and explore new possible scenarios relevant to their future vocation.

Teachers listening to the student voice

Although the results have shown that games-based learning can be effective for student learning, there are other considerations in adopting new technologies in education. This includes the capacity of teachers to engage with the technologies and effectively integrate them into the learning environment. The attention of students in the action and goal-directed pursuit of game goals, which focused on the learning content, meant that students were actively engaged in learning. Students were observed to verbally interact with their peers excitedly as they progressed through the game. These interactions also involved the teacher in lively discussions about the curriculum content. In discussions with the teachers prior to trialling the games, there were comments that they felt students were innately adept at using digital technologies. There was perceived reluctance to adopt the games in their class due to their own low digital self-efficacy. Using the games in the classroom was a new experience for teachers. Instead of dealing with retention issues and disinterest in the learning content, teachers were now in the position of having to actively engage students in the subject matter, content that the teachers were experts in. Student voice is then not only actively present in the development of skills and knowledge in the targeted curriculum, but enabled scaffolding of learning in the Vygotskian (Vygotsky, 1978) tradition. In addition, Lai and Hwang (2015) have shown that being actively engaged with peers in understanding learning

problems, and reflecting and revising their approach based on teacher's comments situated students in higher order thinking.

Engagement and game feedback

Student voice is represented in the playing of the games. When students are navigating the game world, they are in control of their own progression and directing their own learning. They are determining the pace that they learn at and how they approach game challenges. In situations where aspects of the game design provided an obstacle to progressing the activity, student feedback about the game design was fed into the iterative development process to modify and improve the educational game products. Observations of 82 students interacting with the games indicated high levels of engagement, social interaction and motivation to achieve game goals. Survey responses supported this with 78% responding that they found the game engaging. The actionable context which is responsive to the learners' game activity (Barab et al., 2010) provides a level of immediacy and supplies responsive consequential feedback. This feedback is empowering to students by allowing them to experience the results of their in-game decisions by learning through their successes, failures and mistakes in the game.

The gameplay is experiential with players having a defined role and being situated in the vocational space where they and their actions affect a specific context. The challenge supplied by the game is important for cognitive achievement. Cognitive outcomes have been shown to improve with increased interactivity as long as cognitive overload through intensive gameplay does not limit learners' capacity to process new information to enable them to meet the instructional goal. This balance is supported by the survey responses where 65% of students found the game challenging yet at the same time 82% understood what to do. Through performing actions, experiencing consequences and reflecting on the decisions they make, users develop a goal-directed sense of agency as they engage with learning content in games-based delivery. Students' comments represent this perspective and reinforce concepts of learning through gameplay:

> Sometimes confusing, first there's a fire, then you got to put the fire out, then what was I doing, then there's a chemical spill, you can't really focus on one task at one time, I suppose that could be a real workplace, a lot of accidents in one day though!
>
> More interactive than some teacher talking my ears off.
>
> Sometimes it is fun, but with my study, not that much information with my study I get, but when I compare things that are very important if I spend 1 hour playing this game I will learn the things that are very important but I will not get that much information in 1hr of study.

Fun and learning

Students were engaged with the content and interacting with their peers and teacher, and the majority found this an entertaining experience. Of the 82 participants survey responses indicated that 74% of students enjoyed playing the games, 70% had fun and 78% found the games engaging. Coupled with 71% stating that they learnt about the topic playing the game we can infer that having fun and being engaged is linked to successful learning outcomes. This is supported by students' comments:

> It was better than doing the text, it was more interactive, better than just sitting there and looking at a bit of paper, more enjoyable.
>
> ...humour good though, you joke about things, not obviously though, keep it entertaining in that regard, the apprentices learn about it more, sometimes coming across as deadly serious doesn't drum it in as much.
>
> A lot better, good concept, more visual and fun, more interaction, you feel better when you do something.
>
> Sticks with you, you might joke about it but you are always thinking about it.

The connection between fun and learning as expressed from the student perspective is supported by Fu and colleagues (2009) who found that game enjoyment is a key factor in determining player involvement and learning throughout the game. In addition Singhal and Rogers (2002) propose that knowledge acquisition is enhanced when learners are being entertained.

Conclusion

This research demonstrated the importance of student voice for analysing the impact that game parameters have on knowledge acquisition in games-based learning environments and validating a pedagogical shift from content delivery to designing experience. Student voice was also an integral aspect of the iterative development cycles of the educational games in this research by providing a contextualised goal for learner engagement in theoretical subjects, and investigating whether games-based learning adds meaning and context to VET learning outcomes.

This research has shown that involving students in the design and development of interactive curriculum in games-based learning environments can enable interactions among teachers and learners, engage learners by conferring agency, provide a scaffolded sequence to enhance skill development, and align assessments and learning with learning outcomes. Gameplay had a positive impact on student retention where students were observed to remain after class to play the games and engage with the learning content. This was in contrast to comments by one teacher who stated that students would often wander out of the class and not return when conventional pedagogical approaches were used to teach the curriculum addressed by the games.

The games-based activity systems analysed offered stimulation and excitation of the subject in attaining the object of improved knowledge transfer and skill development. Surprisingly, outcomes also included additional understandings regarding the complexity of the social and consequential context of work focused activity. Students were observed to make a shift from being passive receivers of curriculum content to active participants engaged in their learning (Beavis et al., 2015). The actions of participants were adjusted by operations or routine processes in order to orient the subject towards attaining a goal. The Design Based Research iterative development and trial of the games involved transformation of these conscious actions to routine operations, and when operations failed to produce a desired result, reflection through student feedback would result in implementing modified procedures. Student voice activities thereby shift perspectives and position ‘students as the agents of change’ (Toshalis & Nakkula, 2012).

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