

Connecting fun and learning- an activity-theoretical approach to competency based game development

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Games-based learning has the potential to improve engagement and skill development. This research explores the development of the White Card Game and the impact that fun has on learning outcomes. The first-person shooter style game offers a contextualised, situated experience that equips learners with skills and an understanding of the socially complex world of work. The research has approached the analysis through an Activity Theoretical framework. 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 fun within the games-based learning context. This analysis revealed significant increases in knowledge transfer, skill development and engagement with the curriculum in comparison to conventional pedagogical approaches.

Keywords: games-based learning, immersive environments, activity system, fun, scaffold

Introduction

The use of game technologies can provide exciting ways to engage and educate new learners, especially those who may be disadvantaged in conventional learning environments. Games can offer a transformational change in pedagogical approaches by being intrinsically motivating, providing immediate feedback to learners and scaffolding skill and knowledge acquisition (de Freitas & Maharg, 2011). In this study a 3D immersive game environment was developed from an Activity Theoretical (Engestrom, 1987) perspective and some of the outcomes of the game as reported by the users has been analysed in the context of the development and production process. Trials of the White Card Game were undertaken with Certificate 3 in Construction (Carpentry) students who reported a preference for games-based learning compared to traditional delivery methods. They also expressed greater understanding for both the learning content and the relevance to course outcomes.

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 facilitate the analysis of needs, tasks and outcomes in the games-based learning environment. This environment involved developing and trialling a computer game to achieve learning outcomes. The computer game components of the activity system that were examined included a number of parameters including narrative, gameplay and fun. This paper focuses on levels of fun and tests the impact it has on learning outcomes.

Literature review

Games-based delivery can establish a new paradigm where the critical constructs of learning are transformed from information and knowledge units relayed via curriculum to active learning experiences (de Freitas & Maharg, 2011). Critical aspects of games that can offer this transformational change in education include: the intrinsic motivation of gameplay; the responsiveness of the game environment in providing immediate user feedback; and the opportunity to scaffold the delivery of content in order to offer a complex, diverse and engaging learning opportunity. The fun had playing these games can influence these critical aspects subsequently influencing motivation and facilitating learning (Whitton, 2009)

Perhaps the most frequently adopted framework in the study of games was proposed by

Csikszentmihalyi (1992) who conducted research into what makes experiences enjoyable and defined the term "flow". Flow is described as the process of optimal experience, whereby individuals are so involved in an activity that nothing else seems to matter. Making learning fun is a powerful incentive to engage students in the educational process. Players experience the results of decisions they make and are able to influence the game world with a responsive agency that delivers determination and empowerment to the player (Klimmt, Hartmann, & Frey, 2007). This is a challenging active experience and as expressed by Papert (1998) *hard fun* is the enjoyment had from mastering hard and complex gameplay.

From this theoretical perspective serious games have enormous potential to offer alternative viewpoints with their capacity to combine realistic representation and imaginative fantasies in collaborative, participatory spaces. As the games demand instant reactions from player decisions, the feedback loops offer deeper thinking and learning opportunities (Gee, 2007). In a study devoted to measuring learners' cognition of enjoyment Fu and colleagues (2009, p. 111) summarised their findings, "whether or not a game offers enjoyment to the player is a key factor in determining whether the player will become involved and continue to learn through the game."

Methodology

The White Card Game locates the player on a commercial building site. The player creates their avatar, puts on safety gear and independently moves through the building site achieving the game goals of identifying, reporting, assessing and controlling hazards over three levels of the building. The design and development of the White Card Game involved teachers and developers. Research data was collected from: observations of students and teachers in the classroom while students were engaged in playing the game; in-game data collection of students' gameplay activity; hard copy surveys; interviews with students; and communication documentation from teachers and game developers during planning, production and trialling of the games. Ethics approval was granted prior to the research.

The teachers were introduced to the game development process and tools, and were given an indication of what was possible within the constraints of the budget available. This included a demonstration of game mechanics and limitations of user control over fine manipulation of game objects. They acquired an understanding of how the game environment could transfer knowledge through gameplay and also provide a more cognitive focus than practical skill acquisition. Similarly discussion with developers was conducted to ensure there was an understanding for aligning competency based learning criteria with the gameplay scenarios. This enabled the developers to envision how the game design would mediate the learning for the student participants, and in addition gave an occupational context for the game production. Communications data between teachers and developers indicated a transformation in their understanding of pedagogical game design that ensured successful learning and gameplay outcomes.

Educational games provide a context for learning but also create a context through the continual interaction between users and the system. In the analysis of game components the research considers the goals, intentions and interactions of the teachers using the games-based resource, the designers developing the game and the students who are learning from the game. Engestrom's (1987) Activity Theory model describes purposeful interaction of active subjects with the objective world. Activity Theory is specifically concerned with how tools, which represent the accumulation and transmission of social cultural knowledge, mediate activity. This is represented in the top triangle in Figure 1.

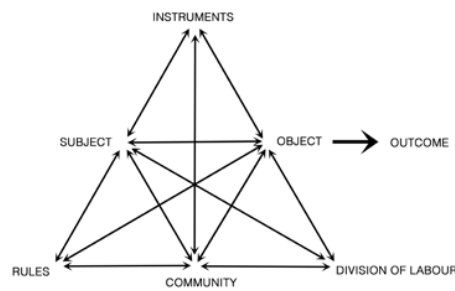


Figure 1. Engestrom's Activity System Model

Engestrom expanded the subject-object interaction to encompass collective activity by introducing "community", thereby creating a three-way interaction among subject, object and community. In addition other means of mediation include "rules" for the subject-community interaction; and "division of labour" for the object-community interaction (Kaptelinin & Nardi, 2012). An important principle of Engestrom's theory is that activity systems are constantly developing, and these developments are driven by contradictions.

The games-based learning activity system in this research situates the learner as the *subject* of the activity. The *object* of the system is the game trial, which encompasses the activity, interactions and contradictions of the components, and as a product fulfills the goals or intentions of the activity through its transformation. This transformation moves the subject closer to the goal or *outcome*, producing knowledge acquisition in the learner. The *community* involves students, teachers, developers and the researcher, the nature of their social interactions and the beliefs and values that define or impact on the activity. This includes their styles and strategies for learning and their interactions with the technology. The communication or *division of labour* component describes technological and face-to-face communications in the design, development and trial of the games-based learning system. The *rules* constrain student users of the game in the subject content they are presented with and determine how game parameters feature in the design along with the learning content. The *instruments* of the activity system refer to the developed game.

Results and Discussion

Activities are socially and contextually bound, so can only be described in the context of the community they operate within. The community negotiates the rules and customs that define how it functions. In the context of the games-based activity the community includes teachers, designers and students. Individuals within these communities, with their different expectations, have had to alter their beliefs to adjust to the socially mediated expectations of the other groups. For instance the time spent on designing specific features of the game world is not necessarily of benefit to the learning experience. This has required a degree of mediation and transformation to address the conflicts between teachers, designers and the researcher who held the role of production manager. Within the context of the games-based activity system the rules defined constraints that facilitated a guided experiential learning process and impacted on the learner's capacity to apply knowledge acquired in the game, to problems or tasks presented in the game-playing context. The contradiction here is that at the same time it is critical to design the game so the user believes they have choice over movement and tasks, and that rewards provide feedback rather than appearing as a mechanism of control (Ryan, Rigby, & Przybylski, 2006).

The results of trials supported a connection between learning and fun with observations of students playing the White Card Game indicating they were engaged with the content and interacting with their peers and teacher. Survey responses indicated that 74% of students enjoyed playing the game, 70% had fun and 78% found the game 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. The results also indicated that the game was more effective for enhancing learning outcomes than conventional teaching methods. This was supported by students' comments:

GG: "Game reinforces issues. You can always read a book but until you put it into action it it doesn't make sense. Book doesn't really show you the safety issues. You need to experience it to really understand it."

ST: "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."

Most of the communication focused on issues of translating pedagogical priorities into gameplay scenarios. The researcher activity was more subject oriented, enabled through delegating object oriented production coordination to the development team. Object oriented teamwork generates production competency and collective expertise (Engestrom, 2008) and in this instance made production communication more direct. However this also introduced contradictions in the activity system. As experienced as the development team was, a lot of the educational products they had worked on had implemented summative assessment processes in the form of quizzes. In these products the user was required to step outside the intrinsic gameplay and undertake more conventional delivery and assessment akin to a mastery learning model (Carroll, 1989). Communications with the team mediated this contradiction. The researcher discussed the priorities of embedding learning within gameplay and introduced concepts of action and goal-directed learning to the team. Also relayed to the team was the need to draw a distinction between virtual worlds and games. This required a significant shift in practice for the team from their experience in designing exploratory 3D world simulations, to including consequences and learning through failure within the gameplay.

The development team's productions to date had not included a capacity for having fun while exploring. This facilitated team development by allowing an opportunity for team members to reflect on the outcomes of the game player as learner. This was highlighted by one of the developers who spent a lot of the production in realistically creating hazardous situations with serious consequences for users who failed to perform safely on the building site. This allowed for the enhancement of a situated learning experience that embraced "context with consequentiality" (Barab et al., 2010). However, at the same time this expansive learning by the team member challenged prevalent practice and managerial values, and in doing so caused anxieties for the team leader whose priority was keeping the project within budget.

This highlights a major shift in the motivations of members of the community in progressing the activity. The motivation of the researcher was the successful completion of the project in order to research the effectiveness of the game. The motivation of the team leader was to ensure financial viability of his company and responsibility to his development team in supplying ongoing employment. The dynamics created through these different motivations all focus on the objects of the activity, but the variations in the way the object is treated has an impact on the success of the activity outcome. As indicated through the transformations of the production team, there was a realignment of pedagogical focus in the development of the White Card Game, which successfully progressed the activity and expanded the existing boundaries of the team.

Conclusion

The White Card Game was developed to meet the needs of a large number of the student cohort with very low English skills and/or previous schooling, and aimed to engage and improve learning outcomes for all students. The findings have shown that the majority of students found that the game provided a richer learning experience than conventional methods. By adopting an Activity Theoretical framework analysis indicated that developmental transformations driven by contradictions were shown to occur in the components of the activity system. These mediated transformations involved teachers, developers and students in the games-based learning context, and resulted in revised knowledge and skills of the learner participants as the outcome of the activity.

The significance and innovation of this research lies in its capacity to deliver new learning contexts that frame the development, integration and use of interactive games-based learning resources. The research outcomes make a significant contribution to sustainable production practices by targeting operational and technical developments and providing the framework to develop and evaluate new pedagogical approaches. This research supports innovation in higher education by identifying

pedagogical and technological barriers that impact on the use of games technology for learning acquisition.

The White Card Game was funded through the VET E-learning strategy and to date there has been over 1000 downloads of the game, including institutions that only need a single copy for sitewide distribution. The game has been recognised as a successful pedagogical platform, having won Bronze in the IMS Global Learning Impact awards in San Diego, 2013, and Simulation Australia - Grand Prize 2013.

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O'Rourke, M. (2015). Connecting fun and learning- an activity-theoretical approach to competency based game development. In T. Reiners, B.R. von Konsky, D. Gibson, V. Chang, L. Irving, & K. Clarke (Eds.), *Globally connected, digitally enabled*. Proceedings ascilite 2015 in Perth (pp. 517-521).

<https://doi.org/10.14742/apubs.2015.926>

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