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TradeAway – Collaborative Game Design and Development as a Learning Environment

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Abstract: Learning games and game-based learning have been taken into use in various fields of education. Even though the use of learning games has been widely studied, not enough is known about how to pedagogically design game development projects as learning environments. In our paper we explore the design and development process of a mobile learning game as a collaborative and pedagogically grounded learning environment. Our research question is: What kind of pedagogical model is needed to support collaborative game design and development process? The goal of our research was twofold: 1) to develop and experiment with a pedagogical model based on collaborative game development, and 2) to develop and test the learning game itself, targeted for learning international business and trade. We applied the design-based research method according to which the pedagogical model was simultaneously developed and tested in practice. In our case study we describe the iterative development of the learning environment and the learning game itself. We will introduce our analytical framework that combines theories and concepts from pedagogy and education sciences. We conceptualize the pedagogical model and learning process as a collaborative co-creation of knowledge within an innovative knowledge-community (triological learning). Our findings describe how the pedagogically grounded learning environment can support collaborative, boundary-crossing learning. The findings highlight the potential of game design and development projects as specific learning environments supporting intensive interaction and knowledge co-creation in higher education. As our main result we present the P3P pedagogical model that guides the teachers when creating learning projects around game development. Our findings will be of interest for researchers, practitioners, and teachers in the field of learning games and pedagogy.

Keywords: collaborative game development, collaborative learning, pedagogical development, learning environment, case study

1. Introduction

Learning games and game-based learning have been taken into use in various fields of education. Even though the use of learning games has been widely studied, not enough is known about how to pedagogically design game development projects as learning environments. The development and design projects of games offer great potential and opportunities for learning across fields, such as information technology, business, and game design, etc. The working life of today and for the future calls for multidisciplinary and collaboration skills, which need to be developed during formal education. Collaborative learning projects offer an authentic environment for learning these skills. In our paper we explore the design and development process of a mobile learning game as a collaborative and pedagogically grounded learning environment within a higher education context. Our research question is: *What kind of pedagogical model is needed to support collaborative game design and development process as a learning project?* The goal of our research was twofold: 1) to develop and experiment with a pedagogical model based on collaborative game development in the context of higher education, and 2) to develop and test the learning game itself, targeted for learning international business and trade.

In this paper we present the development process and reflections on a pedagogical model involving a learning game design project. Students of a university of applied science designed and developed a mobile learning game as a learning project. The game design and development project formed the learning environment for the university students and other collaborators. The learning environment and the pedagogical model were developed by the teacher-researchers in parallel with the implementation of the game design project. Design-based research was applied for developing the pedagogical model.

The rest of the paper is organized as follows: In section two we present our theoretical and conceptual framework, and in section three we present the implementation of our case study. The findings are presented in section four, followed by discussion and conclusions in section five.

2. Theoretical framework

As a part of our case study we developed a theoretical framework that utilizes theories and concepts from pedagogy and education sciences. We conceptualize the pedagogical model and learning process as a collaborative co-creation of knowledge within an innovative knowledge based community. This kind of learning is called triological learning, and it can be seen as one form of expansive learning (e.g. Engeström, 2009) or innovative learning that requires constructing a shared space for learning (common ground, context). In this shared space, knowledge is collaboratively created with the help of various objects (conceptual or concrete), as well as shared practices related to knowledge creation. Both the objects and practices involved in the triological learning process are collaboratively and systematically developed through collective intellectual action in which the individual members of the community actively participate. This collective action is mediated by nature, which means that it takes place through the shared objects, using them as mediators. (Paavola et al, 2004; Hakkarainen et al, 2004; Paavola and Hakkarainen, 2005) Furthermore, the learning group's epistemic agency emerges through participation in the shared activities, i.e., intentionally pursuing its epistemic goals (Paavola and Hakkarainen 2005).

In order to succeed, triological learning requires four elements as pre-requirements: (1) individuals with their ideas and personal knowledge and expertise, (2) a community consisting of individuals interested in participating in deliberate knowledge advancement, (3) a shared space for collaboration, and (4) shared objects (ideas, practices, and knowledge artifacts) that are developed collaboratively, and that mediate the knowledge-creation process of the community. (Paavola and Hakkarainen 2005) Following the ideas and pre-requisites of triological learning, we started to develop the collaborative learning environment for game development. To be able to create a *collaborative* learning environment, we needed to define a structure for the collaboration, and we chose to utilize the concept of "the innovative knowledge community". (Hakkarainen et al, 2004)

Innovative Knowledge Communities (IKC) are groups of people gathered together in order to share and create new knowledge collaboratively. The target of an IKC is to develop knowledge and competencies intentionally and systematically, and the motivation for their existence is the collective creation of knowledge. (Hakkarainen et al, 2004) In IKCs the processes of innovation and knowledge creation are based on 'collectively cultivated epistemic practices that guide and channel the participants' intellectual efforts in creative and expansive ways'. These communities are characterized by three activities: (1) pursuing novelty systematically, (2) working continuously at the edge of current expertise and knowledge, and (3) deliberately re-inventing the community's practices. (Hakkarainen, 2009)

When developing our pedagogical model, our aim was to create support for collaborative learning. We chose the concept of IKC - innovative knowledge community (Hakkarainen, 2009) as a starting point the development, and the developed pedagogical model should include the important elements of IKCs. We

argue that the IKCs form a vital collaboration platform for the students, teachers, and other participants and stakeholders that take part in the activities. Our intention was that the IKCs would include members with varying backgrounds and levels of expertise, ranging from novices to senior experts. In addition, the backgrounds of the participants would include expertise from various fields, such as, business administration, game design and development, coding, pedagogy, and international trade. This multi-disciplinary team would enable a triological learning process to emerge, where new knowledge could be created in collaboration, crossing the boundaries of disciplines and expertise.

As our work was done at Laurea University of Applied Sciences, we needed to take into account also the local pedagogical models. At Laurea, the Learning by Developing (LbD) Action Model forms the pedagogical frame for teaching and learning. In short, the LbD model emphasizes learning in authentic environments through practical development of a chosen object. The LbD model is based on the pragmatic learning theory and integrates competence producing learning and an innovative R&D project. The defining characteristics of the LbD are authenticity, partnership, trust, creativity and an investigative approach. (Raij, 2014) In practice LbD means that the students not only learn by acquiring theoretical information and facts from textbooks and research articles, but also have to apply the information into practice through developing a chosen real-life case or project. Often the cases and projects are offered by companies and other organizations in the university's partner network. The students learn through developing a solution to the authentic case problem. In addition to learning the subject matter, the students also learn the practices and methods of development, creativity, and problem-solving. The LbD model has been implemented, e.g., as a peer-to-peer (P2P) learning environment where teaching and studying is organized as learning projects. In the P2P learning environment, learning is organized in the form of projects. Students form groups with 4-6 members, and each group is assigned a project to work on. Teachers supervise the group's work and the group creates a solution to the given problem. LbD - P2P -framework was the starting point of our pedagogical development work. We first analyzed the strengths and weaknesses of the LbD and P2P models, and compared them with the triological learning model and concept of the innovative knowledge communities. As there were several similarities and connections between these models and concepts, we were able to develop the P2P and LbD models through action research aimed towards the P3P model presented as one of our results (see section 4).

3. The case study

In this paper we describe the iterative development of the learning environment and the learning game itself. First, we will describe the development of the learning environment, and second, we will describe how the TradeAway learning game itself was created as a learning project.

3.1 Development of the learning environment

The learning environment and the pedagogical model were developed following the design-based research method (Barab and Squire, 2004; Barab, 2006). The research and development of the pedagogical model and learning environment was done simultaneously. Design-based research is iterative - the interventions or pilots developing the pedagogical model and practices build on the results of the previous interventions/pilots. Design-based research is preferably conducted in real-life situations to ensure that the contextual factors affecting the learning process are taken into account. We chose the design-based research method for developing the pedagogical model because that method is well suited for studying learning in real-life context (Collins et al, 2004). Moreover, design-based research has an action orientation, which means that things are changed at the same time as they are researched (Reeves, 2006). This was also our goal, to change and develop the pedagogical model and to research it simultaneously. In addition, our development process was collaborative as all actors in the collaboration network participated in designing the learning environment. Furthermore, in terms of pedagogy, we approached the learning game design and

development project TradeAway with the help of dialogical learning theory and the concept of an innovative knowledge community (IKC) as explained earlier in this paper.

Learning games diversify teaching and make more innovative pedagogic approaches possible. Games create a more motivating learning environment than traditional lectures. In the TradeAway project, the learning IKC consisted of students from two universities of applied science, namely, Laurea's business administration students and Metropolia University of Applied Sciences' Game Studio's students (coders), mentors of international trade and innovation, entrepreneurs as consultants, and Laurea's teachers.

All actors participated actively in the collaborative problem-solving and learning process. The shared object of development was defined at the beginning of the project. In this project, the shared object of development was to design and develop a fun and motivating learning game that inspires and sparks up interest towards international business. The students' role was to take active initiative in implementing the task as team members. Business students' were responsible for managing the project and producing the international business content for the game, while ICT students concentrated on game design. Senior Advisor's role was to act as a mentor, and the entrepreneurs acted as consultants for the learning project. The teachers' role was to facilitate and support the learning process through intensive guidance. The teachers had a double role: they taught both the students and tutored the learning projects, and also acted as action researchers developing and researching the learning environment. Teachers also acted as networkers, experts, and evaluators. As a result, all participants were involved in the knowledge creation process, and they all learned through advancing knowledge and practices. The learning environment formed also a good platform of transferring tacit knowledge. In addition, the process supported learning between generations.

3.2 TradeAway game development project

According to Dondi & Moretti (2007) the purpose of the use of learning games is, above all, to support motivation in learning and improve skills and competences, it has an explicit didactic purpose and that can be used, adapted and adopted for supporting, improving and fostering learning processes within formal, nonformal and informal learning scenarios.

Games can be divided into different kinds of taxonomies. Lots of games have been created for special informational needs (Kelly et al, 2007; Amaro et al, 2006; Ogershok and Cottrel, 2004). By using Dondi's & Moretti's classification (2007) TradeAway game can be defined as a decision making game which has a focus on strategy and problem solving skills. TradeAway is a learning game that simulates international trade of goods and focuses on the international business transactions. The game teaches the player different risks of international trade, methods of payment, delivery terms, contents of trade agreements and trade agreement negotiations. The player does business with a number of buyers from different countries by choosing the method of payment, delivery terms, mode of transport, and then negotiates the price for the deal. The game is targeted at university and high school students planning careers in international business, and SME representatives. The game's main purpose is to inspire and spark up interest towards international trade. The game is designed to be fun and easy to play, and it aims to inspire the player to look for more information about international trade to deepen his/her knowledge. Currently, the game can be played with an Android tablet.

The idea for a learning game about international trade related risks was created by Laurea University of Applied Sciences Hyvinkää Campus project management student group in spring semester 2015. It was based on a publication, a guide targeted to SMEs about international trade. During the spring 2015, the initial game idea was developed into a PowerPoint prototype under supervision and guidance of Laurea's teaching staff.

The PP prototype was then used for designing the basics of a mobile learning game by a new student project group in 2015 autumn semester. The playable Android based mobile learning game prototype was ready in February 2016 after six months of developing and testing. It was created in close cooperation between Laurea UAS student project group and Metropolia UAS Game Studio student group. Teaching staff in both universities supervised and guided the development work. Both teams were mentored by a Senior Advisor in Trade Finance, International Chamber of Commerce (ICC). During the project, the game was tested by entrepreneurs, experts, students and teaching staff. The current game prototype includes working game mechanics and seven different countries with different risk profiles to make trade with.

During the spring semester 2016, the project team also started cooperation with a high school of international business and Laurea business students organized a workshop. The main objective for the workshop was to test the game in a real life educational situation. In addition, the objective was to find students interested in joining the game development and collaborating. The game was also tested by Laurea's law students as a part of their business law course to get ideas about integrating agreement negotiations in the game. The cooperation with the high school continued also in the autumn semester 2016 in relation to workshops and game lessons.

Since autumn 2016, new student project groups have been working on the further development of the game. The development has included, e.g., workshops focused on the storytelling and game architecture. The goal of the development work is to produce a complete game product where education and play are carefully balanced.



Figure 1. The TradeAway game

4. Findings of the case study

During our case study we collected experiences from the participants of the development project: students, company representatives, other collaborators and experts, and teacher-researchers. In addition, the development of both the learning environment and the game were documented. Our research question was: *What kind of pedagogical model is needed to support collaborative game design and development process*

as a learning project? As our main result we present the P3P pedagogical model that guides the teachers when creating learning projects around game development especially in the context of higher education. Our findings describe how the pedagogically grounded learning environment supports collaborative, boundary-crossing learning. Furthermore, the findings highlight the potential of game design and development as learning environments supporting intensive interaction and knowledge co-creation.

Our main results are related to the P3P model that has been developed further from Laurea’s Learning by Developing (LbD) pedagogy and peer-to-peer (P2P) learning environment (see Section 2). Our student-driven pedagogical development project has refined the Laurea’s P2P environment into a P3P pedagogical model and learning environment that nourishes co-creation of innovation and entrepreneurial skills and mindsets, and thus facilitates the employment of students. All actors participate actively in the collaborative problem-solving and learning process; students, specialists, entrepreneurs and lecturers all act, develop and learn together. The cooperation in the P3P model is based on intensive interaction, mutual trust, engagement, support, and taking responsibility (Kuhmonen et al, 2015).

The P3P pedagogical model is based on the theories of triological learning and IKCs. To succeed triological learning requires four elements: (1) individuals with their ideas and personal knowledge and expertise, (2) a community consisting of individuals interested in participating in deliberate knowledge advancement, (3) a shared space for collaboration, and (4) shared objects (ideas, practices, and knowledge artifacts) that are developed collaboratively, and mediate the knowledge-creation process of the community (Paavola and Hakkarainen, 2005). These four elements are present in the P3P learning environment and pedagogy and enable the triological learning process and learning the proactive entrepreneurial mindset (Kuhmonen and Pöyry-Lassila, 2016).



Figure 2. The P3P pedagogical model for collaborative learning

In the figure 2 above, the elements of the P3P pedagogical model for collaborative learning are described. The students' role is to take active initiative in implementing the task in teams with a project manager, secretary and team members. Business students' are responsible for managing the project and producing the international business contents to the game, while ICT students concentrate on the game design. Teams work in intensive cooperation, challenge each other and learn from each other by sharing the knowledge. Students think outside the box, and possible solutions emerge. The effectiveness and results of the P3P model are based on the close interaction between the student teams and the mentor or entrepreneur, who act as a coach and a consultant for the learning project, which motivates the students. The teachers' role is to facilitate and support the learning process through intensive guidance. The teachers have a double role: they both teach the students and tutor the learning project, and also act as action researchers developing and researching the learning environment. Teachers also act as networkers, experts, and evaluators. As a result, all participants are involved in the knowledge creation process, and they all learn through advancing knowledge and practices, which improves professional skills and competences of the students and make them more employable. In the P3P model, the processes are transparent and based on the trust, responsibility and support. The model is flexible and can be tailored according to the requirements of the specific development task.

The P3P learning environment provides fruitful conditions for the formulation of innovative knowledge communities (IKC), the development of shared expertise, and co-creation of innovations. The P3P model responds to the challenge of the changing of the role of the universities of applied sciences in Finland as facilitators of learning and networkers that ensure individual career paths for students. The statements of the students in the evaluation discussions indicate that the fact that the responsibility and space for creativity is given to the students and the feeling that they are trusted, both increases the students' belief in their own capabilities and improves their self-confidence, which is important for their future careers and taking responsibility for the development of their own life. (Kuhmonen et al, 2015)

The 21st century workplaces call for an entrepreneurial attitude, skills and spirit (Llopis, 2013). In the P3P model, all actors participate actively in the collaborative problem-solving and learning process: entrepreneurs, specialists, students, and lecturers all act, develop and learn together. The educational target of the P3P model is to facilitate the development of the students' entrepreneurial mindset. The students implement the development project in close interaction with the entrepreneur or other collaborating partner, guided by the lecturer-coaches, whose role is to facilitate the progressive learning process, and act as experts, preparers, implementers, evaluators, and networkers (Raij, 2014). By participating in the P3P projects, the lecturer-coaches are encouraged to redefine their roles as teachers and the pedagogical skills towards supporting the sharing of expertise and the co-creation of knowledge in a multi-actor collaboration.

5. Conclusions

The goal of our research was twofold: first, to develop and experiment with a pedagogical model based on collaborative game development, and, second, to develop and test the learning game itself, targeted for learning international business and trade. We applied the design-based research method according to which the pedagogical model was simultaneously developed and tested in practice. Our findings highlight the potential of game design and development as learning environments supporting intensive interaction and knowledge co-creation. Our findings will be of interest for researchers, practitioners, and teachers in the field of learning games and pedagogy.

According to our experience, we argue that active interaction is a prerequisite for a successful game design and development project since it facilitates and supports the learning and sharing of expertise. For the business students the expertise might mean fresh business knowledge about international trade or game innovation. From the mentor's point of view, the change of ideas with the young generation is rewarding

and facilitates future orientation of the expertise. For the mentor, the share of expertise means also the sparking up of the interest of the students towards international trade. When thinking “outside the box”, students boost new ideas and innovations. – The whole process of designing and developing of TradeAway can be considered a collaborative learning process, states a mentor of the project.

Our observations and experience indicate that from an educational point of view, learning by playing is a great way to get the players to internalize the knowledge they have learned and to practice the theoretical knowledge in an almost authentic context. The player can utilize theoretical knowledge and apply it in practice in a risk-free simulation environment. Through the practical, hands-on approach to learning, the game enables profound learning experiences. Competing solutions for this game are online courses, seminars, traditional learning methods, books, and consulting, although they provide linear and more one-way learning. The game by nature offers a more experimental way of learning as well as dialogical and trialogical learning (Hakkarainen et al, 2011).

The game makes engaging learning possible. Engagement, motivation and flow are the key factors in creating durable learning experiences, specifically in acquiring new skills and knowledge. According to Järvillehto (2014), learning can be intrinsically rewarding and even fun when your teachers and peers are passionate about the content. One way Järvillehto (2014) encourages to “rediscover the fun of learning” is by turning learning into a game, where players are self-motivated to persevere.

Engaging Learning Environment (ELE) is a holistic model of designing new learning environments. It is a synthetic model of innovative learning and instruction that depicts learning as an iterative and cyclic knowledge advancement process. It involves an iterative process of: 1) diagnosing current knowledge and activating a meaningful context to guide and direct learning, 2) going through and facilitating various inquiries in which new knowledge and understanding is produced, and 3) assessing learning gains and knowledge produced so as to engage the participants in an expanding learning and inquiry cycle. (Lonka, 2015)

Based on our case study and constant feedback from the cycles, we argue that in the P3P learning environment, studying is motivating and fun, as intensive interaction, mutual trust and collaboration between different actors fuel learning together, and the project itself works as a fascinating learning tool. According to our experience, we state that learning in the P3P environment is rewarding to the parties involved, as it provides a borderless platform for the students to challenge and discuss more with experienced mentors and entrepreneurs and get mentoring and consulting from the business specialists, advisors and entrepreneurs. In addition, the P3P facilitates the transfer of tacit knowledge and supports learning between generations, but definitely requires shared expertise, constant effort, flexibility, engagement, motivation and trust between the actors.

Our findings have both practical and research implications. First, the practitioners in the field of teaching and learning games could benefit from implementing the P3P model for their students in order to enable multi-disciplinary, collaborative learning projects. Second, the researchers of pedagogy might find of interest the research and development of the pedagogical model presented in our paper.

In the future, the smooth progress of the collaborative game design and development project, where the game coders and content providers are geographically located away from each other necessitates further research. We also suggest that the digital pedagogical solutions related to the P3P environment would be a good target for further research. In addition, the virtual coaching and mentoring related to the P3P environment should be further studied.

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