Collaboration Platform for Public and Private Actors in Educational Games Development

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Abstract. This paper describes innovation platform development for co-creation of serious games. Innovation platforms offer modes of collaboration for schools, universities, citizens, and companies. The main actors of this project are three universities and two science centres in Finland. Several modes for collaboration have been tried in order to discover permanent structures that would benefit various stakeholders. Interests of different stakeholders have been analysed in order to find conditions for successful co-creation. Problems that prevent efficient collaboration have been identified, which are predominantly financial issues. Moreover, some more game-specific issues have been discovered: the understanding of use of games in education and pedagogical goals and methods are not necessarily shared between game developers and educators. Game developers seek to create games that are entertaining, whereas educators want tools that support curriculum goals and enhance learning. However, the idea of collaborative design practices in learning has been welcomed by all stakeholders. In particular, the co-creation in science centres has started successfully, bringing small start-up companies and school students together around educational application development where science centres act as facilitators. Recommendations for best practices in universities are drafted in order to find efficient ways of implementation.

Keywords: Serious games · Co-creation · Innovation platforms · Games firms

1 Introduction

This paper aims at analysing conditions and boundaries for collaboration between various stakeholders on an intended innovation platform for development of educational games. This research follows the methods of innovation action research [1], which is an obvious choice for a study where researchers follow and act as part of the development. The data are based on several projects and experiments that have been implemented in Metropolia and Oulu Universities of Applied Sciences, the University of Helsinki, and the science centres Heureka and Tietomaa in Finland. The efforts of the Edudigi project to create an innovation platform are analysed, and data from similar endeavours are compared with this particular process. The main focus is on

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collaboration patterns and how successful different ways of implementing co-creation have been. There is already many years of accumulated experience of development of serious games with various partners in these institutions, but the changing situation in the games and mobile applications marketplace needs continuous reassessment.

The project has been implemented as part of the European Union (EU) sponsored Six City strategy, which is described as follows: "The Six City Strategy runs between 2014 and 2020 with the aim of creating new know-how, business and jobs in Finland. It is funded by European Regional Development Fund, European Social Fund, the Finnish Government and the participating cities. The Six City Strategy has three focus areas: open innovation platforms, open data and interfaces, and open participation and customership" (p.n.p.) [2].

This paper first briefly discusses use of games in the classroom and the current research on educational games. Next, the idea of an innovation platform and different stakeholders in educational games development are presented, and the current situation for each stakeholder is analysed. Next, several efforts in collaboration between public and private actors in forms of projects are described, major obstacles are analysed, and some lessons learnt during the projects are listed. Finally, conclusions on collaboration patterns are drafted.

2 Educational Games in the Classroom - Current Research

In Finland, the new National Core Curriculum (2014) emphasises using games and gamification in learning [3, 4]. Playful learning is seen to advance learning and as a motivational factor in both information and communications technology (ICT) skills and in different subjects such as mathematics or languages. While digitalisation has entered children's lives, there is still a huge variation in how digitalisation and digital games are being used in classrooms: more than 80% of the teachers report that they need additional training for ICT use [5]. Many teachers are having difficulties in implementing digitalisation in schools so that it would truly support and advance the ways that the students use ICT. However, gaming has been shown to motivate students, spark interest towards new knowledge, as well as to build bridges between formal and informal learning [6].

The use of educational games is increasing both in primary schools and in higher education. Additionally, many virtual learning environments increasingly offer "gamified" features such as badges and points, without really ensuring that they enhance learning. The assumption has been that gamification is good as such, because it is presumed to motivate students. Several studies on the usefulness of games in learning have been published, including a meta-study in 2012 by Kapp [7]. Kapp had collected six carefully chosen meta-analysis studies that each examined a large amount of studies that attempted to resolve the issue of effectiveness of games in education. The studies compared reported learning outcomes of game use to other methods, but the result was inconclusive. Overall, in more than half of the cases games were found somewhat beneficial. Kangas et al. conducted a meta-study on teacher involvement in game-based learning in 2017, noticing that there still is a scarcity of research in this field [8]. Plass et al. recently presented ideas for viewing game-based and playful learning through

cognitive, affective, behavioural and sociocultural levels of learner engagements, which offer foundations for analysing successful learning both from the features of the game and its pedagogical context [6]. Much depends on the type of game, how it is supported in the classroom, and what kind of learning it is designed to produce.

Research in serious games and gamification spans various disciplines, and it is still at a nascent stage, as concluded above. There are journals that are inclusive to games research such as the International Journal of Serious Games (online) but most research is published across various platforms including educational technology conferences. The research results from academia are therefore hard to locate, and have not yet fully reached the commercial world or schools.

3 Methods

Kaplan [1] outlined a version of action research that engaged the researcher in an explicit programme to develop new solutions, and to evaluate and improve the solution in a research cycle that he called innovation action research. In the research that is presented in this paper, the method seems a natural choice, as the researchers follow and act as part of the development effort, where publishing intermediate steps also works as an evaluation tool. Action research is a form of field research, largely descriptive and qualitative, consisting of a set of cases for analysis and testing theories. The data in this study are based on several projects and experiments that have been implemented in three universities in Finland, with the authors as members of development teams or observers.

4 Stakeholders on Innovation Platforms

4.1 Innovation Platforms

Innovation platforms are defined as environments that enable the development of new products, services and markets, allowing the entire city community to work together to create new services, solutions and businesses. This indicates that innovation platforms are tools that cover the entire life cycle of a service, from idea to testing and from testing to product. Innovation platforms were created to offer effective and functional services for agile trials, user-oriented joint development, and controlled user-testing of new innovations and technologies [2].

The Edudigi project in the cities of Espoo, Vantaa, and Oulu is an experiment to create a platform for collaborative development of educational games. The actors of the project are three universities and two science centres in those geographical areas. Several modes for collaboration have been tried and analysed in order to discover permanent structures that would benefit various stakeholders, including universities, primary schools, games companies, and science centres. Figure 1 explains the intended setup of the innovation platform, showing the stakeholders in the city of Oulu.

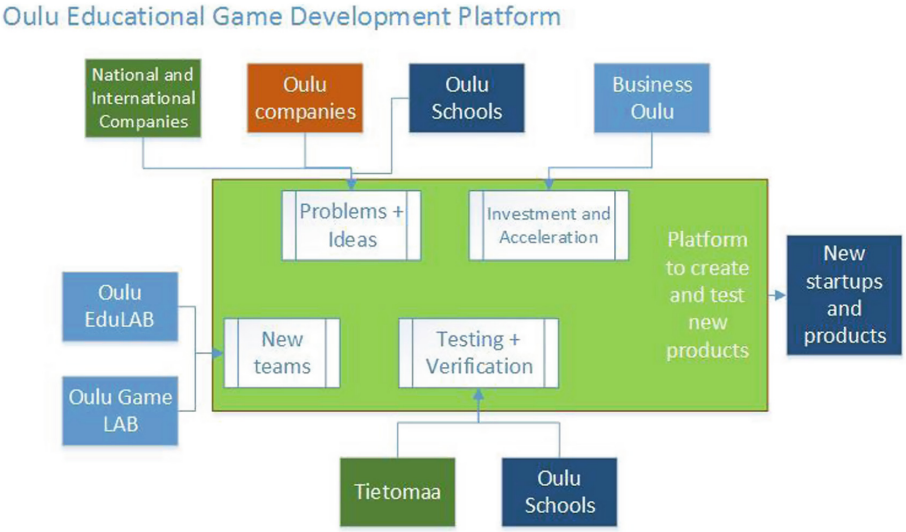

Fig. 1. Oulu educational game development platform

4.2 Games Companies

Games companies are predominantly small, often start-ups. According to a survey by the national Finnish funding agency TEKES, there were around 80 companies that were developing serious games in 2016 [9]. However, in an effort to map their activities in 2017, only less than ten firms were found to be continuously developing and selling games for public use. Most were producing games and other software as a service, or had stopped functioning. On the other hand, over 30 other companies have started since then. Many firms are start-ups with one game or a family of games. About a half of the games that were brought to the market were free, whereas 26% were sold as a direct purchase (premium model). Some of the games had a more complex earning model such as yearly or monthly subscription, school licence or a freemium model. The freemium model is dominant with commercial mobile games where players pay for extra services or goodies during the game. These games have been developed to hold the attention of the player, or even to create an addiction. This kind of model is seen as unethical when children are concerned, and therefore should be avoided in educational games [10].

According to the above-mentioned survey, financial problems are the most important impediment for the growing of the firms. One large problem is with the earning model compared to developers of entertainment games, where the players are customers and pay for the games. The question arises, who is the paying client when a game is used in school? Schools favour open source, free software because of lack of funds. Most of the above-mentioned free games had been developed in some project with public funding. Unfortunately, the development and maintenance of the game usually stops when project funding ends, and the products soon disappear from the market. A few financially successful products have been developed without a connection to school curricula, such as Yousician (where you can learn to play a

musical instrument) and the language game WordDive. Language teaching applications abound for mobile devices and personal computers (PCs) also globally. Additionally, there is a category of educational games that has been developed by enthusiastic school teachers or university educators. Many mathematical and science games belong to this category, as well as learning environments based on map-related activities [11].

One of the ideas of the innovation platform for serious game development was to connect educators and pedagogical experts with game developers. However, the games firms do not seem to feel a strong desire to get help neither in usability or pedagogical issues, nor in game development as such. This was obvious in the TEKES survey [9], and it is illustrated by responses to later efforts to contact the firms and to market pedagogical knowledge to them. Money matters are most urgent for small businesses. Moreover, the market for classroom materials and textbooks is dominated by a couple of large publishers who can also provide gamification as part of the teaching material.

4.3 Schools and Teachers

Education departments in municipalities have an active policy to encourage digitalisation of schools according to national strategies [3]. In practice, the most popular measurements locally have been purchases of tablets, computers, and other hardware. On the national level, there are several government funded projects to enhance digitalisation, such as trials of virtual reality gear in some school districts. Teacher unions have conducted surveys among their members and complain that teacher training in digitalisation has not been a priority, and very little time has been allocated to the training [12]. Recent studies show that teachers have difficulties in implementing new practises of ICT in schools [13]. In fact, even though teachers reported to use ICT in schools, most of the use in classrooms is teacher-driven and the main aim has only been to show students facts, for example, using Microsoft (MS) Power Point. Internet is mainly used as a source of information. According to the students, ICT was used less than what the teachers reported.

However, an active cohort of teachers participates in networks that develop uses of virtual and digital tools. Some act as mentors for their colleagues, who are less knowledgeable. Teachers who are willing to participate in development efforts, can be found through the existing networks.

4.4 Educational Institutions: Higher and Vocational Education

Since the remarkable global success of the local commercial entertainment games industry in 2010, universities in Finland have been involved in game developer education and various projects to develop new games. The ministry of education as well as the board of education have granted funds for the projects, many of which are also funded from European sources. Currently, 6 universities and 11 universities of applied sciences have some kind of degree specialisation that has “game” in its name. The first students from these programmes graduated in 2016 [14, 15]. Additionally, education is provided by 10 vocational schools. The games industry was worth 2,400 million euros in 2015 (turnover). However, it only employed 2,700 people [15]. Those figures indicate that the investment in the education for professionals in that field is very strong.

Despite the strong interest in educating games experts and creating company contacts, universities have not shown that much interest in using games as part of the educational toolkit. Exceptions are business and industry games that are widely used in business schools and other universities. Fields that evidently would be suitable for educational games such as engineering, have developed astonishingly few educational games.

A thesis that surveyed the attitudes of vocational school teachers and students in construction, heating, ventilation, and air-conditioning (HVAC) teachers in particular, found that the instructors did not see any use for mobile game applications in their education, even though most students expressed interest in learning through the games. Teacher answers showed lack of knowledge of mobile application use, and reluctance to devote time to something new and unknown. If the games were part of the textbook materials, they would have accepted them. The respondent population in this survey covered about half of the vocational teachers in HVAC in Finland, 96 people [16]. A newly-designed game prototype in a related area, namely electric installations, has just been released and was tested by two groups of students, vocational and engineering students. The six engineering students who were already certified electricians found this three-dimensional (3D) game on PCs useful and interesting. According to the electricians, practicing electric installations in reality is slow, and going through alternative solutions takes considerable time. A game offers quickly many challenges and a safe environment to fail and retry.

4.5 Students

Currently, most young people play mobile or computer games daily, at least in Finland. According to the nationwide survey on playing habits, 80% of the population between 10 and 30 years play some kind of digital games regularly [17]. The age group 10 to 19 years is most active, and 52.2% of respondents from that group play some kind of digital game daily, and 81.6% weekly. This part of the population plays digital games on average 12 h per week. In fact, 25% of them report having some kind of time management problems because of the game playing. The modes of playing vary between ages and gender, as girls and young women play more mobile or social games such as Candy Crush and Hay Day, whereas boys and young men play more car driving and fighting games on game consoles. However, it seems clear that playing digital games is a common activity among the student population, also internationally [6], and young people have no aversion against games.

5 Modes of Collaboration in Game Development

5.1 Co-creation of Games in Science Centres

School groups regularly visit science centres to heighten interest in science. Science centre exhibitions are planned to support active learning and participation. New modes of presentation and latest innovations in science and technology are attractively presented. Nowadays, tinkering is an important aspect of the ideology of a modern science

centre; challenges in the exhibition are open-ended, and visitors can create and experiment with various alternative solutions. Therefore, science centres are well suited to be collaboration hubs for co-creation in game development.

The two science centres in this project have developed a procedure to contact games companies and schools in their surrounding areas, and have created a platform for testing and collaboration sessions. School groups can combine a game session to the science centre visit, or they come particularly for a game development and evaluation session. Game companies can pose their questions to the students, let them try to use their prototype applications, or generate ideas for new educational games. The companies have direct access to young people's feelings, and moreover, they get teacher insights into the educational value of their products. The types of games have not been limited into any particular variety and have included mobile applications as well as virtual reality games.

This service has proven to be popular among game companies as they can avoid the bureaucratic procedures of contacting schools and acquiring permissions from parents for evaluation sessions. The facilitators of the science centre support the co-creation process by motivating the school group. Students learn about the innovation process by practicing it themselves. Different kinds of brainstorming tasks are an essential element in the session. It has to be emphasised that the students are the actual experts in the co-creation process (see Table 1).

Table 1. Structure of the co-creation process

1st visit *Science centre* facilitators motivate pilot users; problem solving tasks; pilot groups' own innovation process begins Introduction to co-creation session, start-up presentation, co-creation and feedback
2-3 weeks break *Schools:* Homework *Start-up:* Further development based on feedback
2nd visit Pilot groups' own innovation process continues; presentations Introduction to co-creation session, start-up's greetings, co-creation and feedback

Around 700 school students have participated in co-creating products of 15 different companies in one science centre. The evaluation methods have been tailored for each company. Sessions have been observed and sometimes videotaped, and participants have answered questionnaires after the session. This has given the researchers a great amount of data on children's approaches to games. The companies have

participated in co-creation sessions to a varied degree. Additionally, they have received summary reports of the findings from the facilitators. The service has been provided for free due to various sources of project funding. Whether companies will be willing to continue to use the service when they will be charged, is yet an open question.

Student eagerness to participate in co-creation has been positive, even though their learning has not been ensured. Students have been offered a glimpse into the game development process, and a chance to influence the resulting products, which they have found inspiring. The real interaction between the entrepreneur and the student is a cornerstone of the process. If the entrepreneur is deeply interested in the feedback, the co-creation process is an empowering experience for students. Evaluations by teachers reveal what kind of skills teachers believe their students learned during the process. Product development process, teamwork, brainstorming, causal relationships, and argumentation are often mentioned.

5.2 Games Development in Universities

Universities have a variety of collaboration units, some with purely educational goals, and some with commercial interest. There are separate development laboratories, called Game labs, Games Studios, or the like, which offer students a chance to get involved in real projects ordered by outside firms or organisations. In those laboratories, methods of team software or games development are applied, and students have an opportunity to learn industry practices [15]. They might also get support in founding start-up businesses, which usually takes place in business incubators that are attached to universities. One university also has a game-related learning centre that gives start-up businesses a chance to participate in a couched six-month accelerator programme.

As long as the game development activities are mainly geared towards educational goals, the experiences and outcomes have been positive. However, when commercial interests are counted, more ambiguous results are shown. University projects seldom can produce outcomes that fulfil commercial requirements, and they function best for idea generation and prototype creation.

Universities have been involved in various student projects where gamification of educational content has been explored in collaborative settings [18]. We have earlier reported trials of collaboration between primary schools and various groups of university students, which have been successful in educational terms, but no commercial product was ever delivered. Additionally, there has been educational game development together with large enterprises and, on the other hand, with start-up companies. The fields of application involved health care and health education, engineering education and simulations [19].

6 Discussion

Crucial problems that prevent efficient collaboration have been identified, such as different timespans and periods of activity in educational institutions and private companies. Large enterprises are more tolerant with time issues, as the activity is only of minor importance for them, and they can afford a small investment without quick

turnover. Small start-ups work on very short timespans, and the delays that are caused by school semesters and terms, and timing of project activities, can be restrictive. Experience has shown that when the school or university was ready for the collaboration, the start-up had already been engaged in something else. On the other hand, financial issues are always central. Firms have to take the most lucrative deals, therefore they might abandon a school project that had been started in favour of a well-paid project.

Another set of difficulties involves questions concerning privacy, especially when minors are involved. Public projects and institutions have to act openly, and the intellectual property rights are granted to students when they are involved; moreover, public grants demand open sharing of results. Companies would like to keep business secrets and secure their own intellectual property rights (IPRs). However, these could be seen as practical problems that can be solved by careful drafting of contracts. Many universities have developed their own contract forms for these situations. In case of underage children, permissions need to be acquired from parents for activities that make them test subjects or targets for photographing or videos. Because school districts act locally, there are many different models for this.

Aside from these general concerns in collaboration, some more game-specific issues have been identified: the understanding of use of games in education and pedagogical goals and methods are not necessarily shared between game developers and educators. Moreover, organisational cultures in the game development world and in public education are far apart. The views could be summarised simply as follows: game developers seek to create games that are addictive and fun whereas educators want tools that support curriculum goals and enhance learning. For example, a new educational game Big Bang Legends has many entertaining and addictive elements, but it offers high school physics to primary school age children. Therefore, schools have little interest in it, but it might function as a commercial success as a game.

7 Conclusion

Certain basic requirements have to be met in order to have a functional innovation platform for co-creation. Before creating or maintaining the platform itself, there has to be a clear shared vision across all parties. How are the different parts of the concept seen and how have the meanings been negotiated? The main actor or centre for the platform has to be reliable and easy to reach by all parties. The platform needs constancy and continuity, which is achieved when there is a strong commitment to it among the major parties. As was detected in this study, personal relations and individual interests cannot be forgotten as, after all, everything works through people. Finally, a sound earning or funding model has to be established, otherwise financial pressures will make the operation impossible.

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