TEKNILLINEN TIEDEKUNTA

SERIOUS GAMES IN TEACHING OF BASICS OF PROJECT MANAGEMENT

Laura Kauppinen

TUTKINTO-OHJELMA

Kandidaatintyö

Maaliskuu 2020

TIIVISTELMÄ

Serious games in teaching of basics of project management.

Laura Kauppinen

Oulun yliopisto, Tuotantotalous

Kandidaatintyö 2019, 13 s. + 2 liitettä

Työn ohjaaja(t) yliopistolla: Jaakko Kujala

Tässä kandidaatin työssä perehdytään vakavien pelien hyödyntämiseen yliopisto-opetuksessa. Vakavat pelit ovat nousussa oleva aihe. Tätä lähestytään kahden kysymyksen muodossa. Kuinka vakavia pelejä on hyödynnetty korkea-asteen koulutuksessa ja kuinka vakavat pelit vaikuttavat motivaatioon. Kirjallisuudesta nousi esille moninaisia vakavien pelien hyödyntämiskohteita kielen ja kulttuurin opettamisesta ohjelmointiin ja datan visualisointiin. Avainkohdiksi tarkistelluissa tapauksissa nousi läpikäyminen jälkikäteen ja soveltuva haastavuusaste parhaiden tulosten saavuttamiseksi. Nämä kaksi tekijää paransivat oppimistuloksia ja opiskelijoiden motivaatiota aihetta kohtaan. Empiria on hankittu opetustapahtumasta huhtikuussa 2019 Tampereen yliopistolla. Tapahtumassa projektinhallintaa pyrittiin havainnollistamaan pelin avulla, sekä vahvistamaan jo käsiteltyjä aiheita kurssilla. Opiskelijoiden näkemykset kerättiin Likert-tyyppisellä kyselyllä ja täydentävällä avoimien kysymysten osiolla. Opiskelijat kokivat pelaamisen hyödylliseksi opetustyökaluksi, joka havainnollisti projektinhallintaa korostaen opiskelijoille riskien hallintaa. Suurin hajonta mielipiteissä koski turhautumista käsittelevää lausuntoa. Opiskelijoilta kerätty palaute sisälsi myös jatkokehitysideoita pelin tulevaa kehittämistä varten. Näitä tuloksia hyödynnetään pelikokemuksen jatkokehityksessä ja kandintutkinnon kokoon keräämisessä.

Asiasanat: korkea-asteen koulutus, pelillistäminen, projektinhallinta

ABSTRACT

Serious games in teaching of basics of project management

Laura Kauppinen

University of Oulu, Degree Programme of Industrial Engineering and Management

Bachelor's thesis 2020, 13 pp. + 2 Appendixes

Supervisor(s) at the university: Jaakko Kujala

In this bachelor's thesis, the goal is to look into how serious games are used in higher education. Serious games have been a topic on the rise. This topic is approached in the form of two research questions. How serious games have been used in higher education and How the use of serious game affects motivation? In the literature, there has been a high variety of field in which serious games have been applied, from languages and culture to programming and data visualization. Debriefing during or after the event and appropriate challenge level rose as the two most important factors to reach good effects on learning and studying motivation. Empiric section for this thesis was gathered at a teaching event at Tampere University in April 2019. In the event, the game was used to teach project management basics. Data was gathered from students using Likert-type questionnaires and open-ended -questions. Students experienced the play session as a useful tool in the teaching of project management, especially regarding risk management. The highest variance was on a statement regarding frustration with the game. Feedback gathered from the students contained also suggestions for the future development of the game. These results can be used to future improve the game.

Keywords: higher education, serious games, project management

SISÄLLYSLUETTELO

1 INTRODUCTION

The goal of this bachelor's thesis is to investigate the effects of applying a serious game in a university course setting. The course in question is the first course that the students take in the field of project management. The game itself focuses on teaching the management of the critical path and risks involved in project management. In several literary reviews the overall effect of gamification in learning seems to be positive, though contrary evidence is also present (Dicheva et al. 2015; Majuri et al. 2018; Boyle et al. 2016).

Key terms used in the thesis are serious games and educational gaming. Serious games were defined by Djaouti et al. (2011) as a videogame structured piece of software that has a non-entertaining purpose. Terms between serious games and educational games are often used interchangeably (Boyle, et al., 2016). For the rest of this thesis, serious games are referred to as games, and the entertainment variety is referred to as videogames. As a related term, gamification was defined by Deterding et al. (2011) as of the use of design elements characteristic for games in non-game contexts.

The research questions for this bachelor's thesis is twofold.

1. How serious games have been used in higher education?
2. How the use of serious game affects motivation?

These are first looked in the light of the previous studies. Literature answers to the first research question. After the literature examinations, we investigate the topic in empirical case-study format.

2 LITERATURE REVIEW

2.1 Previous literature reviews on serious games

Serious games have been a popular research topic (Majuri et al. 2018). The results from such papers vary, generally trending toward positive or neutral in higher education, though the amount focusing on teaching session was not high (Backlund and Hendrix 2013). Most of the games in the review were computer games that were evaluated by using questioners (Calderón and Ruiz, 2015), as those were most abundant. Other used methods included laboratory experiments (Grund and Schelk, 2019) for games and participation rates from gamification platform (Deterding et al. 2011).

The teaching session forms from two parts, gaming and debriefing. Sometimes only one is included, in example Gresse von Wangenheim, et al (2009) had only the gaming part, while Grund and Schelk (2019) used video debriefing without the gaming session as a control group. Debriefing is one of the most important parts of the session. During the debriefing, students go through the experience and reflect and analyze the results of the session. This is one of the most important parts of the teaching event, as this help transferring the results from the teaching session to outside the classroom. (Nicholson 2015)

In several literary reviews, the overall effect of games and gamification in learning seems to be positive, but neutral and negative evidence is also present (Dicheva et al. 2015; Majuri et al. 2018). There is a strong possibility of improved results in learning if appropriately implemented (Dicheva et al. 2015), but the effect of different aspects of experiments can be difficult to separate (Majuri et al. 2018). Serious games had positive effects on engagement, improved interest and better motivation (Roozeboom et al. 2017). Some commonly reported effects of usage of gamification were improved engagement in forums, attendance, participation, better passing rate, and easier to learn on top of those reported for serious games (Dicheva et al. 2015).

The following chapters will look more in detail based on some case studies done around the topic. These are split into two categories, effects on motivation and learning outcomes.

2.2 Motivational effects

Across the cases looked into, students reported higher level of engagement (Hsin-Yuan Huang and Soman 2013; Gresse von Wangenheim et al. 2009; Guillén-Nieto and Aleson-Carbonell 2012; Pourabdollahian et al. 2012; Soflano et al. 2015), as well higher levels of initial interest on the project due to use of game (Guillén-Nieto and Aleson-Carbonell 2012). Interest was highlighted by volunteers gathered from variety of fields (Soflano et al. 2015). The improved motivation was suggested by Gee in (2003). As voluntarism is one of the defining features of play, this also supports the other motivational aspects of games (Nicholson 2015). Challenges the game presented to the players enhanced the feeling of engagement to them (Pourabdollahian et al. 2012). Improvements regarding motivation were also found by integrating the debriefing into the game (Grund and Schelk, 2019). Regardless, they found no correlation in intrinsic motivation, when comparing traditional presentation and game session, though some of this might be attributable to small sample size.

Gamification is the practice of applying game elements, such as leader boards and experience points on non-game context (Deterding et al. 2011). Significant improvements in the amount of student interaction with teaching staff and assignments were returned on average more than two days before the deadline, compared to less than day previously. 76% of students claimed that the system was helpful to their learning.

2.3 Effects on learning

Improvements on the students learning varied between neutral, to positive results. In the game "It's a Deal!", the goal of the game was to improve the student's skills in an international business environment, where business was done between Spanish speaking and English-speaking people. The shared language was English. Results trended towards positive. Some of the results were attributed to the appropriate briefing beforehand and debriefing in the end to improve learning. (Guillén-Nieto and Aleson-Carbonell, 2012)

When switching focus in the business field to information visualisation, Grund and Schelk (2019) created a game to teach principles of business information visualisation, based on a standard of the field. The participants were divided into three groups, to determinate the effect of a serious game and the difference caused by two tested

debriefing-methods, in-game and post hoc. The post hoc debriefing was given as a video presentation to enable comparison. The third group got a more traditional presentation on the matter in video format, which was same as the post hoc debriefing video. The games enabled improvements in learning outcomes, while students rated the traditional presentation more appropriate method for teaching. Some of the difference in results and rating might come from being more used to traditional presentations.

Soflano et al. (2015) gained positive results as well when it came to learning compared to traditional paper-based format. The goal of their game was to teach SQL to students without previous touch on the topic. While results were better in all groups compared to paper-based format, some differences were found inside the student groups when it came to learning effectiveness. Generally, there was no difference between learning styles, but some groups had better effectiveness. Soflano et al. commented that this could also be caused by the imbalance between participation numbers of different groups.

On the neutral side on the learning results was text-based prototype designed to teach software measurement (Gresse von Wangenheim et al. 2009). Unlike the improvements presented earlier, the effect of the game on learning was neutral (Gresse von Wangenheim et al. 2009). They pointed out several reasons why this could be the case. First, the session before the game was described as "dense" and the game was perceived difficult. The perception might point toward to the too low level of previous knowledge on the topic. Also, the debriefing was not held. (Gresse von Wangenheim et al. 2009) Similar results were obtained by Roozeboom et al. (2017) on their three cases. Roozeboom et al. also pointed out that the traditional multiple-choice might not be a good method to assess learning from serious games, which could impact the results.

Games seem to have multiple sources which contribute to their success. While the effect of the customs seem to have an impact on how players view the situation (Grund and Schelk 2019), the assessment method seems to impact as well (Roozeboom et al. 2017). The level of challenge in the game has an impact on the learning, as too challenging game does not have an impact on learning (Gresse von Wangenheim et al. 2009). This can be impacted by implementing debriefing into the teaching session or in the game (Grund and Schelk, 2019). Debriefing also improves the impact the session has overall in retainment of the learned information (Nicholson 2015). Based on the literature the hypothesis is that students find serious games intrinsically motivating, by both novelty and native interest.

3 EMPIRICAL RESEARCH

3.1 Case description

The teaching event was held at Tampere University. The students were on the basics of project management, which is their first course on the topic. In the start of the lecture, there was a half an hour introduction to the game and how it worked. Students were told how the score is formed and how to gain extra points for the final grade of their course from this session. Students were also noted that these points go on top of the points they have gathered through the course; this was not mandatory to get the best marks. Included were some tips relating to timing, planning, how to interpret the net and colours/symbols in the game. After this, students were given 45 minutes to complete the game. If the students completed the game very quickly, there was a chance to play a bonus game for other surprise rewards. After the gaming part, there was debriefing to go through the events that happened in the game and how these related to project management. The debriefing contained analysing the original plan the team put together, what actions they took for risk management and was the critical path defined and how it impacted the plan.
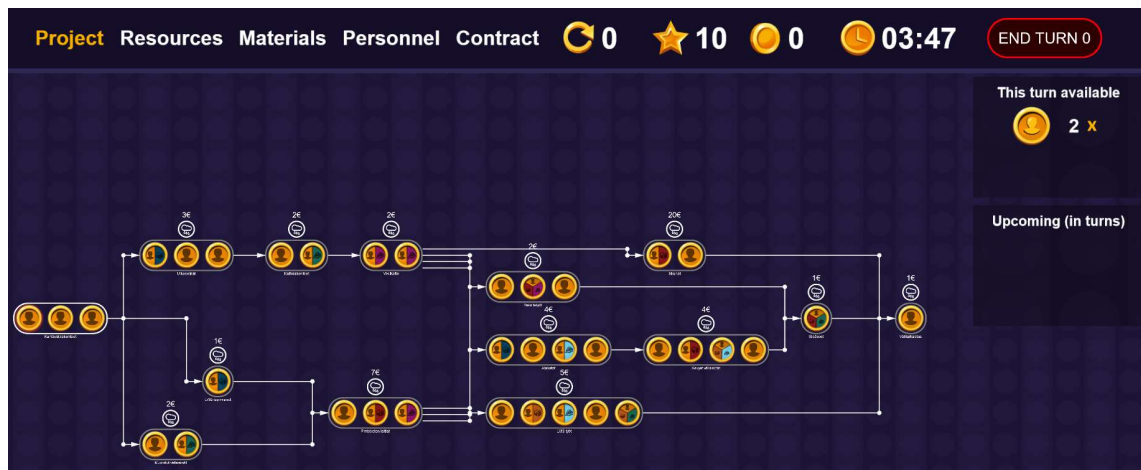
Figure 1. Example of the task net.

In the game, the players must complete a project represented by a task net within a certain amount of turns. This is represented in figure 1. Each step of the project can take different amounts of turns to complete, as well as specialised resources and materials. These can be reserved ahead of time for a cost while being more affordable the earlier, they are reserved. The projects come with risks related to the type of project. These risks can have

different effects on the project, varying from slowing the proses to loosing of materials that were reserved and drop in quality of the result. The winning condition is to make as much profit as possible. Expenses were formed from costs related to the project. If the project was not completed in time, there was a penalty. Also, the quality of the finished project had an impact on the score, in the form of a fine or bonus payment.

3.2 Research Method

The data was gathered using a questionnaire given to students at the event after the gaming session was over. The student answered in groups in which they played the game. The questionnaire was used to assess how the game was perceived by the students, and to find if there were bugs and problems in the game. The questions that are listed below were answered on a scale from 1 to 5, with 1 being strongly disagreed and 5 strongly agree. These are referred to as questions 1-9 through the rest of this thesis. Questions 6 and 8 were formatted as reverse questions, for sanity checking and reviewing internal data integrity.

Q1.   I enjoyed the playing experience.
Q2.   The game was easy to learn/understand.
Q3.   The actions in the game worked as I thought they would.
Q4.   I was able to complete the assigned level without trouble.
Q5.   I was able to use what I had learned on the course in-game.
Q6.   While playing, I felt frustrated.
Q7.   The game helped me understand project management better.
Q8.   I thought the playing session was pointless.
Q9.   I would like to have these kinds of learning experiences in the future.

These were accompanied by three open questions, listed below. The groups answered in Finnish or English, as the language was left up to participants choosing. The answers are broken down in appendix 1 for the Likert-type scales and appendix 2 for the open-ended questions.

Q10.   In your own words, how would you describe the playing session?
Q11.   What were the most challenging aspects of the game?
Q12.   In your opinion, what could be improved about the game?

4 RESULTS

Students enjoyed the session while pointing towards problems in the Likert-type questions. High variance on the score rating the frustration suggest some of the elements of the game might need honing. Open-ended questions offered some insight, on which aspects the focus could be focused, to improve the results. In the end, students still wished for similar experiences in the future and felt the session improved their understanding of project management. The following chapters present a breakdown of the results on the Likert-type and open-ended questions. In total 33 teams answered the questionnaire.

4.1 Likert type scales, questions 1-9

Figure 2 presents the means and variances of each of the Likert type scale questioner questions. Figure 3 presents how the groups scored each of the statements. While most of the questions were formed with high score meaning good results, questions 6 and 8 were formatted as lower score means better results, to ensure that the questions would be red and answer accordingly. Highest rated statements were questions 1 and 9, with as good results from question 8 as well. While on a large scale, the students were unanimous, question 6 was an exception, with high variance, formed by even distribution across all the answers. A more detailed look into each of the scored statements is in the following chapters.
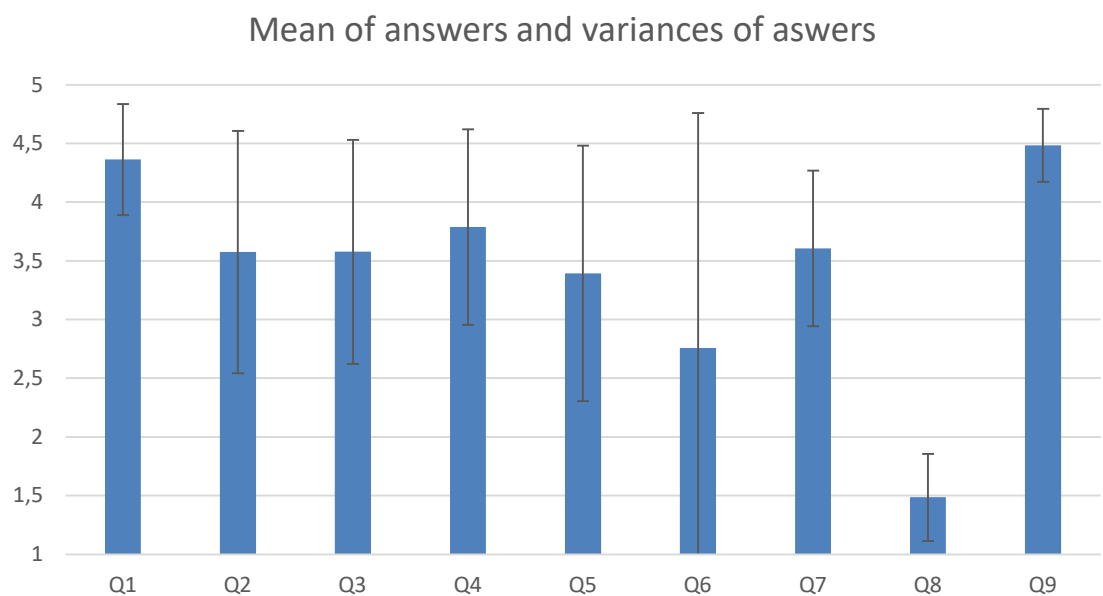

Figure 2. Mean and variance of answers to the Likert-type scale questions.

Generally, students scored the statements regarding enjoyment of the session highly. The enjoyment is emphasized by the high scores on question 1, which has second-highest mean, with second-lowest variance, with 4,36 and 0,47 respectively. Most prevalent scores were 4 and 5, which is also reflected in the mean score. Also, question 9 with the highest mean and lowest variance, 4,48 and 0,31, respectively, show that students enjoyed the session, as wishes for similar experiences in the future highlight the fact. While these two questions scoring reflect highly on how much the game was enjoyed, the relatively high rating of question 6 shows that there is still room for improvement, as students rated the session somewhat frustrating, with mean of 2,76. The question was formatted as a reverse expectation so that a lower score would be preferable. The relatively even distribution of scores, with a variance of 2,00 shows that there are some problems in the game that should be worked on in the future. The open-ended questions provide some insight in which ways this could be done.

Students rated the game as relatively easy to learn, with 4 being the most common score and mean being 3,58 to question 2. The variance of 1,03 is around average on the statements. The rating is also reflected on answers to question 3, where the most common score was 3 when rating how the actions, they took in the game corresponded with expectations. The mean of 3,58 and variance of 0,995 points towards instructions being one of the areas where the game has room to improve, as the student's opinions were relatively divided. Another area was shown in the answers to question 5, where the most common scores were 3 and 4. The question regarded to the relevance of the event to the content of the course, as this was used to measure how well the session related to the content of the course. The students were relatively divided in their opinion, as the variance was 1,08. The mean of 3,39 is still on the higher half of the scale.

Challenge level of the game proved to be appropriate, which was reflected on the answers to questions 4, 7 and 8. With the most popular score of 4 on both questions 4 and 7, the game was not too challenging to pass, and it helped to gain an understanding of the topic. The mean of 3,78 on Q4 with the variance of 0,834 show that students were somewhat dived on the challenge level, as the variance is on the middle range to these results. Mean of 3,61 and variance of 0,663 make question 7 to have a similar position. The students were the most united in the opinion that the session was not pointless. Scores to question 8 were low, with the most common answer being 1, with means 1,48 and variance of 0,37.

As this was worded in the form of a reverse question, a low score means good results. Distribution of the scores is shown in figure 3.
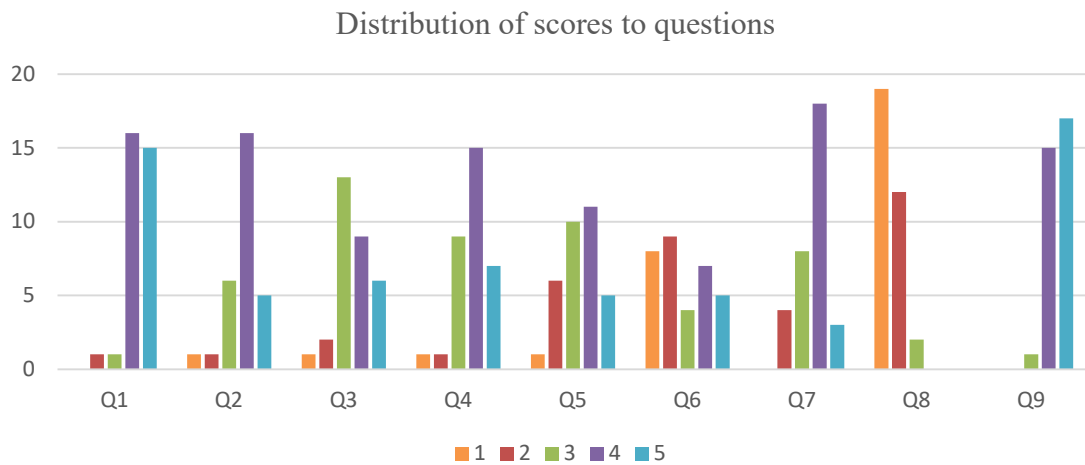

Figure 3. The distribution of the scores to the liker type questions.

In conclusion, the results from the Likert-type scales tend to trend on the positive side. The variances fall in the range of 0,663 to 1,09 indicating relatively high unity in students' opinions regarding the challenge level, connection to the course and improving their understanding of the topic. Students were most divided on their opinion on the frustration level of the game, with the variance of 2,00 and most united in enjoyment, the meaningfulness of the session and hope to have this kind experiences in the future, with variances falling between 0,31 and 0,474. The highest-rated statements were regarding enjoyment of the session and wish to have this kind of experiences in the future with means of 4,36 and 4,48, respectively. While the lowest mean in the Likert-type questions was 1,48, it was on a reverse scale, so the students did not consider the session pointless. Most of the statements had a mean in the range of 3,39 to 3,79, with this covering the questions of 2, 3, 4, 5 and 7. With variances ranging from 0,663 to 1,09 shows that students were somewhat unanimous in their opinion. The students were most divided on feeling frustrated while playing. The variance was 2,00 and the mean 2,76. As this was a reverse statement as well, a lower score would mean better results.

4.2 Open-ended answers, questions 10-12

Answers to open-ended questions are listed in appendix 2. There is a mix of Finnish and English answers, due to the ability to use either of the languages. Choice of language was made to encourage a higher amount of answers and to gain different perspectives from a

variety of backgrounds. Answers are categorised based on points they had in the tables 1-3. Categories were formed based on common points in the answer. As one answer could have several points, the total of points is not the same as the number of answers.

As gathered in table 1, most of the students found the session nice and fun way to approach the topic. High scoring on questions 1 and 9 also correlated with this well. Two of the answers described the session by the limitations the time caused, and hurry it caused for them. The answers correlate well with the results gathered from the Likert type questions, as the most common score was 4 or 5 on question 1. The echoes from the time limit can be seen affecting the score of question 6, which had the highest variance, and the closest average to three, which is the median answer.

Table 1. Aspects the student used to describe the session, gathered from answers to Q10

Nice & Fun	7
Interesting	4
Intensive	3
Running out of time	2

Risk management and surprises rose as the most challenging aspect most often. These are related to one another, as risk management was required to mitigate effects the surprises, as it could have a direct impact on the score the players receive. As the game is still being developed, honing of the game's features rose as one of the topics. The zoom was problematic for some players, along with UI and there were requests to implements project management tools. Time management was also mentioned as one of the more challenging aspects of the game. Challenges with time management were also reflected in the answers given to question 10. Answers are categorised in Table 2.

Table 2. The most challenging aspect of the game gathered form answers to Q11

Risk management	5
Game mechanics	4
Time management	3
Surprises	3
Choosing between options	1
Resource management	1

Suggestions on how to improve the game are also valuable in a few different ways. As the game is developed in the future, this allows for ideas in which areas to focus. These also act as another way to gain insight into the challenge curve of the game and the session as a whole. While some of the suggestions would not be implemented, as they are counteractive to the learning goals, it still offers insight into the experience. Improvements to the descriptions and help-menu were on the top of the requests list. Risk management was a popular topic on this as well. New tools such as insurance and ability to lock storages were requested, as well as the removal of the thieves from the game. Some of the help-menu suggestions also touched on the risks as well, in the form of requests for all the different types of risks involved, and the odds of them. Clarification on the forming of the score and how the costs form could also serve as a motivational effect, due ability to see how the game is progressing, as well as a method to reduce the frustration the game causes.

Table 3. Improvements suggestions gathered from answers to Q12

Improvements to descriptions & help	8
New features for risk management	3
Clarification on costs / how the score is formed	3
Features to the user interface	2
Clearer requirements for employee education to tasks	1
Elimination of certain risk types	1
Longer session	1
Tools for project management	1

The open-ended questions provided more detailed views to the aspects the Likert-type questions pointed towards in the responses. Most of the students described the session as fun or interesting, but time management was pointed out as a challenge across all of the open-ended questions. Risk- and resource management were topics that rose in two of the questions. Some points for the future development of the game was also gained.

5 DISCUSSION AND CONCLUSIONS

As literature highlighted, the development and use of serious games in education are growing (Majuri et al. 2018). As the field is new, results have varied from neutral to good (Dicheva et al. 2015). In cases examined the ones which reached good results, few shared factors arouse. Use of debriefing at the end of the session improves the retention of the knowledge and putting the information into context (Nicholson 2015). Also, an appropriate challenge level is important for the game (Gresse von Wangenheim et al. 2009).

In our session there was an instructional part at the start, to reduce difficulties arising from the game's UI and mechanics. Debriefing after the mater also provided the students with context regarding the event. Our game focused on teaching project management which was presented in the form of task net. To keep the project going in an allocated timeframe, the way students also had to keep risks and managing them in mind. In the end, the score was tallied, and extra points towards the course grade given in proportion to the position they reached. As voluntarism is one of the key features of play (Nicholson 2015), the best marks on the course did not require participation in the event.

5.1 Impact of serious games on motivation

Literature highlight the intrinsically motivational effect the use of serious games has in an educational environment. Due to novelty of the session (Guillén-Nieto and Aleson-Carbonell, 2012) or from the engagement the game provides in form of challenges (Pourabdollahian et al. 2012) or scoring and leader boards (Deterding et al. 2011). In the feedback the students provided in the open-ended questions, interest in the game as a teaching method was one of the highlighted ones.

The scoring on the Likert-type scales also showed that the students enjoyed the game. As questions regarding similar experiences in the future and enjoyment of the playing experience were highly rated. One of the pitfalls Gresse von Wangenheim et. al. (2009) highlighted was avoided, as students thought the level played in the session did not cause too much trouble, actions functioned as they expected and the game was easy to learn. Even though the variance of the question of frustration was the highest, Grund and Schelk (2019) pointed toward a possible solution: integrated debriefing.

5.2 Suggestions for the future development of the game

Frustration with the game was the aspect with the worst score. Potential ways to improve could be formed with the help of the open-ended questions results. Open-ended questions also showed other sources for the high variance, as instructions and descriptions in-game were one of the most suggested improvement topics. Also integrating parts of the debriefing into the game as Grund and Shelk (2019) could improve the situation on this front. Integration of debriefing could also lead to improvements regarding the usability, as the students rated the effect their moves had as 3, which means there is room to improve.

Another point that arouses from the open-ended questions requests for more obvious costs and how they generate. It could ease the planning for the students, as well as clarify how the score is calculated. While more advanced project management tools would also ease the game, it also could act counteractive to educational goals, because then the basics would not be used as thoroughly. Basics are still the baseline that else is based upon, so benefits for knowing them in development and case the project management tools are not available can be significant. Chance to gain access to more advanced tools with increased challenge level in the game as a type of "New game +" could act as a motivational boost to some students, in the form of "bragging rights". This also would not add too heavy of a learning curve at the start of the game, as they would also be familiar with the base game's mechanics at this point.

5.3 Critical evaluation of the research

The data was gathered using Likert-type questioner with open-ended questions in a teaching event at Tampere university. While the sample size was decent, 33 teams that played the game, it did not cover the whole class. This can introduce bias in the questionnaire results. Also, the sample is homogenous, mainly forming from students of technical fields in their first or second year of studies. Another form of bias also potentially rose from the fact questionnaires were filled by teams. When scoring statements, the form of a group could hide some of the variances within the team. Students scored the Likert-type questions on a scale from 1 to 5, with 1 being strongly disagreed and 5 strongly agreeing. Generally, students rated statements regarding their enjoyment highly, with reasonably high unison, shown by low variances on these statements. Highest

variance shown was on a statement regarding frustration the players experienced, which shows dispersion in their opinions. Potential reasons for this was pointed out by the open-ended questions. Time management was one of the points raised across the open-ended questions, which could be one of the sources of frustration.

5.4 Future research

Future research on the topic is needed, as the application of serious games in higher education is new, and not yet standardized. One aspect that could show interesting new information would be playing the game with students that are used to having games as part of education. As these tools are on the rise on lower levels of education, results gained from serious games in higher education could also change as the teaching method is not a new experience. As customs the students have formed around studying are more towards traditional lecture. As students grow more accustomed to serious games, comparisons with other teaching methods might also turn more comparable. Another factor that could be interesting to investigate could be the students' background in gaming.

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Appendix 1: answers to Likerts type questionares

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9
4	4	3	4	4	2	4	1	4
5	5	5	5	5	1	5	1	5
4	4	4,5	5	2	2	3	2	4
4	3	4	4	5	2	3	2	4
4	3	3	3	4	5	4	2	5
4	3	5	4	3	1	4	3	3
5	4	4	3	3	1	4	2	5
2	1	2	3	1	5	2	1	4
5	5	5	5	3	1	4	1	5
4	4	5	2	3	5	4	2	4
5	2	3	3	5	2	5	1	5
5	4	3	1	4	5	3	1	5
4	4	3	4	4	4	3	2	5
5	4	4	5	4	1	4	1	4
4	4	4	5	3	4	3	2	4
4	4	3	4	2	3	2	3	5
5	3		3	2	4	2	1	4
5	5	5	4	3	5	4	2	4
4	2	2	3	4	2	4	1	5
5	4	3	3	4	4	4	1	4
5	4	4	4	2	4	4	1	5
5	3	4	5	3	2	4	1	4
4	5	4	3	3	3	4	1	5
5	2	3	4	3	1	3	2	5
4	4	3	4	2	1	4	1	5
4	2	3	3	4	2	4	1	5
3	4	3	4	3	4	4	2	5
5	4	3	4	4	2	2	1	4
5	4	3	4	5	2	5	1	5
4	5	4	4	2	4	4	1	4
4	3	4	4	4	3	3	2	4
5	4	5	5	4	1	3	1	5
4	2	1	4	5	3	i4	2	4

Appendix 2: Answers to open ended questions

The text is as was written in the form, including typing errors. If the students wrote two separate lines, the answer was as well split on two lines, to maintain formatting.

Q10:

- Ihan kiva
- Pelaaminen oli mielenkiintoista ja se pakotti miettimään asioita tarkasti. Pieni kilpailu oli kannustavaa
- Kive
- Hauska, kiinnostava, intensiivinen
- very funny game and concept! However, the look of time caused sloppiness, which reflected on our plans
- It was all fun and games until we saw our score
- Mielenkiintoinen, jännittävä
- Intensiivinen mutta hauska
- Uusi kokemus, mielenkiintoinen
- Alussa suunniteltiin rauhassa
  Aika meinasi loppua ja lopussa päätöksiä paniikissa
- Hauska, hyvin aikataulutettu ja innostava
- It was educational

Q11:

- Haastavinta oli muistaa tehdä kaikki tarpeelliset siirrot ajallaan.
- Arvioida riskejä ja vertailla eri ratkaisuja
- Riskeihin varautuminen
- Zoomaus toiminto oli surkea, riskejä oli monia
- resurssienhallinnan suunnittelu
- When something unexpected happened, we only had 2-3 minutes to calculate the most optimal way to proceed. The hurry caused ua ti forget about some resource that ourprevious plan relyed upon, and it costed us deerky to realize the sitsuation many turns later
- the surprise delays and fires
- Random events and playing without tools
- Ohjeiden puute, riskit
- aika

- Riskit, mitä vakuutuksia kannattaa ottaa

  varkausvakuutus

- Pelin logiikan ymmärtäminen

Q12:

- Peliin voisi sisällyttää sääennusteen sekä lukitun varaston (lisähinnasta)

- Kustannukset olisi voinut tuoda selkeämmin esille (numeroita joutui kaivelemaan ohjeista)

  Voisi olla näkyvillä, mitä tehtävää tekee kouluttamaton ja mitä koulutettu

- Selkeämmät ohjeet kustannustekijöistä ja pisteiden muodostumisesta. Muuten loistava konsepti!

- Add more descriptions to actions in game

- Sattuman osuutta voisi pyrkiä vähentämään ja lisätä peliin listan, josta näkee kaikki mahdolliset riskit

- Varkaat pois

- Riskien todennäköisyydet

  Help-valikko!!!

- I wish we had more time

- Better instructions and clues about the suprises

- Project management tools implemented would help to plan the game ahead. Tools would give more perspective to understanding project management as now it was kind of light-heartedly playing a game

- ohjeet

- Sopimuksen selkeys

  Jos varas tulee, viekö se kaikki resurssit? Voisi olla ilmoitettu

- Ohjeistus puuttui

- Yllättävien asioiden ikkunaa olisi hyvä pystyä liikuttamaan. Esim. Kysyttäessä alennetaanko laatua olisi hyvä pystyä katsomaan tehtäväverkkoa

- Käyttöliitymän läpikäynti yleisesti ennen pelisessiota

- Eventissä oli valinta -2 laadun ja untrained workerin poiston välillä, jos ei ole untrained workkeria, ei tapahdu mitään

- Disallow end turn if no employe is doing anything. Didn't work on firefox on linux. Chromium did work, but required allowing "dangerous" scripts