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Institute of Computer Science

Marika Zirk

Gamification for Software Engineering Education

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Supervisor(s): Dr Dietmar Pfahl

Dr Margus Niitsoo

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Tarkvaratehnika hariduse mängustamine

Töö lühikokkuvõte

Antud bakalaureusetöö eesmärgiks on uurida mängustamist ja selle rakendamise võimalusi hariduses, eelkõige tarkvatatehnika hariduses. Bakalaureusetöö tulemusena valmis esiteks teoreetiline osa, kus käsitletakse mängustamise mõistet, selgitatakse välja kuidas oleks võimalik selle printsiipe kasutada õppetöö parandamiseks ja tuuakse välja nende rakendamise juhised. Teiseks valmis konkreetse aine mängustamise plaan toetudes teoreetilisele materjalile, soovituste arutelu ja antud õppeaine õppejõu hinnang töö käigus väljapakutud soovitustele.

Võtmesõnad: mängustamine, haridus

Gamification for Software Engineering Education

Summary

The main goal of this thesis is to find out what gamification is and if and how it could be applied in the context of education and more precisely in higher software engineering education. The main outcome of the thesis is firstly, summarising theoretical material on gamification for education. Among them a set of guidelines for undertaking the approach are drawn out. Secondly, gamification plan of a course based on the theoretical materials, discussion on the proposal and a preliminary assessment on the suggestions by the course leader.

Keywords: gamification, education

Author's Declaration of Originality

I hereby declare that I am the sole author of this thesis, and it is submitted to The University of Tartu Institute of Computer Science for obtaining Bachelor degree in Computer Science curriculum.

This thesis is not been submitter for a higher degree to any other University or Institution.

Thesis author Marika Zirk

(signature and date)

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Introduction

Gamification is a notion that has become popular in business [1] and also it seems in education [5, 10]. The starting point for this thesis is a thought that students, who are future game and software developers, could be motivated and inspired by the elements that gamification could add to the course. Motivated students in their turn could ideally mean better learning results and eventually better IT specialists.

The objective of this work is to find out what gamification is and if and how it could be applied in the context of education and more precisely in higher software engineering education. The thesis gives an overview of the nature of gamification and how its application in the field of education has turned out so far. Also the analysed approach has been theoretically tested out on a programming course of University of Tartu.

There is a lot of literature on the topic of gamification. The most famous authors in the field are Jane McGonigal and Kevin Werbach, who believe that gamification is a powerful tool that can be used in almost anywhere. More education focused gamification has been looked at by Gabe Zichermann and Lee Sheldon. However, there is no summarising literature on the gamification process in education and how it actually has to be carried out.

The main method used during the process are combination of inter-disciplinary work and review-type study. During the interview with the course leader unstructured interview was used. The recording of the interview can be found in the Appendix 1.

The thesis consists of several parts. The first chapter gives overview of games, gamification and its techniques from the educational perspective. Examples of gamified educational projects that have been done so far are brought out. Based on the theoretical background and the examples, the author tries to draw out the main approaches that could be considered while going through the gamification process. Second chapter focuses on the selected course, analysis part, selection of gamification techniques and elements that are proposed and discussion on the potential outcome. The chapter is concluded with suggestions for implementation. The third chapter gives a preliminary evaluation of the proposition. The thesis ends with a summary where the main questions of the thesis are answered and directions for the next step are given.

1. Gamification Theory

1.1. Games and Gamification

According to Jane McGonigal „*Life is hard and games make it better*“ [3]. People enjoy playing games as it is perceived as something fun and mostly rewarding. But what exactly are the elements of a game and why we do find them so enjoyable? According to Jane McGonigal all games share four different traits: a goal, rules, a feedback system and voluntary participation. She sees games as something very special in our lives. She writes in her book “Reality is Broken“ that games are opportunities to do something we are either good or getting better at. Even more, she believes that games as such are the opposite of depression as they give us “*an optimistic sense of our own capabilities*” and “*an invigorating rush of activities*”. The main traits that people tend to like about games are:

- they give voluntary obstacles,
- they allow us to use our strengths and do something enjoyable,
- they give clear goals,
- there is no fear of failure,
- they generate and strengthen social connections. [3]

This means games hold a lot of good qualities. It is only natural that there has emerged a group of people who try to distil the attractive elements of games and use these game design elements in other fields of life to make them more appealing to people. Jitendar Maan writes in his article about gamification and how it in its essence takes game design elements like goals, rules, playfulness, elements of fun, feedback, rewards and promotions and applies them to solve what he calls real world problems [15]. Thus, gamification as an approach is in a way a problem solving modification technique. However, it could also be perceived as something more viral. Kai Erenli analyses gamification and comes to a conclusion that gamification is a virus that spreads through non-game elements through gamificational treatment [16].

The word “gamification” has become more and more popular. It can be seen in computer magazines, in the business field but also in articles about education. One could wonder, when did this word appear in the first place? According to an article “Gamification: Toward a Definition“, the word gamification originated in the digital media industry and the

first documented usage dates back to 2008. The word became especially popular in 2010 when many conferences on this topic were held. [7] Thus the word itself is rather new. It also explains why it seems there is still no equally understood concept of gamification. It is only logical to ask if there is actually true content behind the very catchy word itself. Detering, Dixon, Khaled and Nacke come to conclusion that even though there is still a need to determine whether the term and gamified applications are significantly different from previous areas of research in order to accept gamification as academic concept, they still believe that the gamification does represent new research possibilities [7].

If one tries to find out more about the subject of gamification, one will find out that there are actually two aspects of gamification. Firstly, it is an idea according to which our everyday life is seen as a big game, where one gets points either for brushing ones teeth or for eating cereals. One of the visionaries of this field is Jesse Schell [8]. Second interpretation of gamification, as pointed out in an article by Detering, Dixon, Khaled and Nacke, is a concept through which gamification is seen as a valuable approach for improving non-game products, services, or applications. The idea behind it is that since people enjoy playing video games. Then through using the same strategies, it is possible to produce experiences that the customer will enjoy and keep on doing voluntarily. [7] To narrow down the scope of the thesis, the author of this paper will focus mainly on the latter aspect of gamification.

1.2. Definition

Zichermann and Cunningham propose a definition according to which gamification is "*The process of game-thinking and game mechanics to engage users and solve problem*s" [2]. Witt, Scheiner, Robra-Bissantz talk about gamification that is implementation of game principles and mechanics, like points, leaderboards or levels, in a serious context [23]. Werbach and Hunter define gamification as "*The use of game elements and game-design techniques in non-game context*" [1]. A very similar definition is proposed by J. D. Prince according to whom gamification is *"…a new technology that incorporates elements of game play in nongame situations. It is used to engage customers, students, and users in the accomplishment of quotidian tasks with rewards and other motivators*" [6]. As the second

definition is more widely used, the author has decided to use that one in scope of this paper. Thus, gamification is

"*The use of game elements and game-design techniques in a non-game context*".

The following chapters give an overview of these game-design techniques that are of crucial importance in the gamification process.

1.3. Gamification in Education

According to Jasper Juul games give us very clear rules and challenges that cannot be easily overcome. Moreover, he defines a game as a learning process where the player has to solve the problems through improving his skills. [14] Here one could ask, that if games could be interpreted as a learning process, could it also be vice versa.

As it turns out there are already several thinkers who believe that games are a vital part of education. One among them is Prensky, who calls for dramatic game-based reform [22]. His ideal school not just uses games, but is a game itself. Jane McGonigal writes that „*we can no longer afford to view games as a separate from our lives*", by which she means that games are already an inseparable part of our daily life [3]. Thus, games should also be a part of our educational system. So, what could education benefit from applying the game elements and what could be the potential problems?

Landers and Callan write in their article how gamification is not about making an educational game. Instead, they believe that gamification in the context of education means taking the motivational properties of the games and layering them on top of the educational activities in order to motivate students to act. [21] Gamification is seen as a method that can offer a great deal of improvement in the educational system. It is believed to be an approach which could make the students perceive the typical assignments as fun, enjoyable and rewarding [3, 10, 21]. It can also be a method that can offer the course leader a tool that helps to reward the students for any wanted activities [21, 10]. But it is not only the students who could benefit from the approach. Landers and Callan go even further and state that unlike educational games where the goals are fixed by the programme, the right method of gamification is more powerful, as it gives the course leader a chance to direct attention in the class according to the needs of the course [21]. Thus, gamification could be seen as a beneficial approach that could make the education system more appealing to the

students and also give the course leaders new ways to motivate and lead the subject towards set goals.

However, according to Kevin Werbach the challenge in using gamification is to make the existing school system better and not worse. He adds that in the same way gamification can contribute to improvement, it could also harm the educational system instead. The latter can happen when the gamification is done in an inconsiderate way, resulting in students who are given incentive to focus only on the awards and not the learning process itself. [4] So it means that when using the gamification approach, one has to be aware of all its potential areas of conflict to be able to predict potential outcome.

One could also ask whether gamification in the classroom definitely has to mean using computers or any other sort of technology. It turns out that it is not so. Just like games, gamification could be done without expensive technology [1]. The challenge for the course leader in the whole gamification process is to find the right and functional methods that would work in the particular classroom and students.

1.4. If and How to Gamify?

In order to find out whether it is a good idea to gamify or not, Kevin Werbach brings out four main notions to be considered:

1. **motivation**- it is important to find out if there are areas where it would be possible to gain some sort of value from encouraging behaviour; some great candidates are emotional connections, unique skills, creativity and teamwork that could benefit from gamification;
2. **meaningful choices**- the target activities of the future system have to be sufficiently interesting, the students have to be given a choice to choose between them (gives them sense of autonomy); if the gamified system offers only rewards and no freedom of choice, the students will soon get bored and will lack motivation to move forward;
3. **structure**- it is essential that the desired behaviours could be remodelled through algorithms so to measure them and respond to actions; the possibility to track and record user activity in an easy way is also of great importance;
4. **potential conflicts**- here one should consider all the aspects of gamification and the possible conflicts that might arise from the motivational structure (elements like

leaderboards can be demotivating for some people), it is important to identify all the existing ways of motivation and think about how they would function in the gamified system to select the most suitable ones. [1]

The next step would be to find out how exactly the gamification works. Dubois and Tamburrelli write that even though there has been some research in the field of gamification, all that these works present are abstract gamification ideas that have been applied in specific cases [20]. It turns out that there has been no research done towards finding out the rules how the approach should be applied depending on the peculiarities of the system. So, there are no rules of thumb about how gamification should be applied to get the desired results.

However, there have been documented attempts to gamify education and software engineering. Passos suggests that when gamifying software engineering, one could take the whole cycle and divide it into tasks and assign each task a certain number of completion points [19]. However, he does not actually bring out any concrete strategies for gamification or does not list the steps how it should be done in practice.

Dubois and Tamburrelli propose in their paper an actual strategy to gamify the software engineering course. It is not very detailed, but gives the three main activity types that need to be carried out in the process.

1. **Analysis activities**

   The goal is to analyse different gamification approaches to select the most appropriate ones. They also propose to investigate the definition of game rules, the use of reward and penalty mechanisms and metrics, achievement systems, reputation mechanisms, and cheating/over fitting prevention.
2. **Integration activities**

   His focus is on the development of software modules/plugins for introducing gamification elements into the software development process. They propose targeting a specific development environment such as Visual Studio, automatic code analysis, reporting tools and collaborative development framework.
3. **Evaluation activities**

   Application of the methodologies and the modules developed during analysis and integration activities. Here one needs to find out whether the gamification approach selected is working compared to non-gamified or differently gamified system. [20]

In the analysis activities one also has to look closer at the gamification design framework. The latter will be discussed in the following sub-chapter.

1.5. Gamification Design Framework

Gamification design framework is the core structure of gamification. Down below framework´s six steps are described based on Kevin Werbach [4]. The author of the thesis has also tried to add some context connected to the educational system (i.e. what it means in terms of using gamification approach in software engineering education).

1. Define business objectives

Here it is important to list all justified (ultimate) goals one wants its gamified system to accomplish. In case of education, the desired course objectives could be written down. Also one needs to identify what will determine failure or success, i.e. some kind of a metric system that will help to evaluate the success of the methods applied.

2. Delineate target behaviours

Target behaviours are the specific things that the user should want to do. For example in the education system, target behaviours could be that the students want to attend classes, are motivated to complete and hand in their assignments and do well in their tests. Again, success metrics have to be defined that will allow to decide whether the goals have been achieved (also called "win states").

3. Describe your players

Here one needs to look closer at the future players. The description of their age, behaviour, potential motivators, different needs and even sometimes their income could add valuable information.

Kevin Werbach in his lectures says that to think like a game designer we should think of participants as players. The aim is to firstly get the players playing and secondly, keep them playing [10]. Thus, the gamification approach has to offer some sort of attractive features that would generate interest. However, people are not identical and cannot be motivated in the same way. Actually, there are many different types of players. The most famous classification is Bartle´s player types according to which it is possible to categorise

all players under four main types:

- **achievers-** they are typical gamers and they play to win;
- **explorers**- players who like to try out new things, explore and discover;
- **socialisers**- like to interact with others, being on teams, being part of community, like chatting;
- **killers** - people who not onlywant to win the game, but also to impose on other people. They are a small, but important part of players, being the most intense and aggressive participants. [17]

Zichermann and Cunningham write that if one takes the average player, it turns out that Bartles player types are inclusive, meaning that a typical player usually has characteristics of all four types at the same time. Another interesting fact pointed out by Zichermann is that in case the types were not inclusive and each player could be just one out of four, the vast majority of people (75%) would be socializers. With both explorers and achievers being second (10% each) and the smallest group would be killers (around 5%). [2] It is important to note that each of the players can be motivated by different elements.

At the same time Bartle also criticises his own work, as his model suggests that players do change over time, but it does not say how and why. Nor does it predict any subtypes of each player. Figure 1 illustrates the most typical progression from killer type to explorer, to achiever and finally to socialiser. [18]

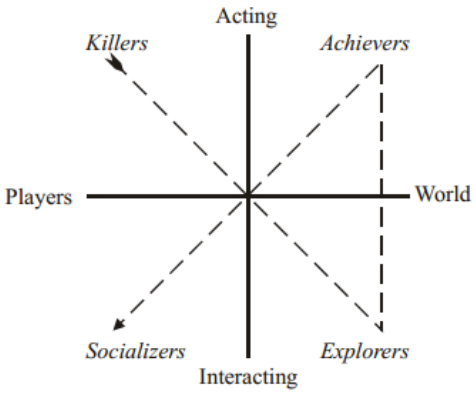

Figure 1. Barle player types (player evolution from killer to socializer) [18].

All the players are thus individual. In terms of education it must mean that there are different types of students that all need an individual approach as each of them might have different motivators, needs and interests. One could wonder that if most of the players are

usually socialisers, then it would be just wrong to use competition as the main tool for motivation. If one wants to translate player types into education context, one might also look at classification used by Berkling and Thomas. They categorise all students into three main types:

1. **applied type** - student who is more into applying the obtained knowledge, is not very fond of too much theoretical context;
2. **grade optimizer** – student who is interested in the good grade with the minimum amount of work;
3. **the inquirer** – is interested in the content that is most relevant for the future or present job. [9]

As mentioned above, the motivation of each player can be different. A student who is a grade optimiser socialiser has different goals and hence motivators than applied killer type. It all means that motivation system as such has to be very carefully planned. But, as Werbach writes, it is important to keep in mind that gamification is definitely not just a reward system. One should be careful not to oversimplify, as game elements do not always produce motivation. Also, generalisations should be avoided as not all people react to the same stimuli the same way. [1]

One very important aspect of motivation that has to be discussed separately due to its importance is immediate feedback. Not only can unexpected and informational feedback increase the feeling of autonomy, but also contribute to growth of intrinsic motivation [1]. The latter is the most valuable form of motivation and will be discussed in the following pages. Kevin Werbach believes that the importance of feedback lies in the fact that players like to get reinforcement on their progress. Moreover, they will regulate their own behaviour based on which metrics are provided to them. [10] In the next section, motivation is looked at on a broader scale. It turns out that there are two main types of motivation: intrinsic and extrinsic.

Extrinsic motivation

Extrinsic motivation could be defined as a feeling that you **need** to do something. It is motivation that is enhanced and driven by outside rewards like material goods, status, praise, points, badges, leaderboards. [1] As showed by case studies that are published in Lee Sheldon´s book, they can be good incentives for students. Also, in case of Ohio Valley College

of Technology, the leader of the course claimed that by offering experience points and creating avatars, he managed to enhance key intrinsic motivation factors. [5]

However, there is a down side to the extrinsic motivators. Social psychology research has shown that extrinsic rewards can have a negative effect especially on motivation and creativity [26]. It is also important to stress that rewards, badges and achievements tend to motivate players as long as they are not anticipated and come as a surprise. [1]

Werbach talks about "hedonic treadmill". The idea behind the concept is that once rewards are given out and players are responding to them, the crucial point is not to stop. He brings an example of car traffic and speed signs. Just because there are signs that make people slow down does not mean that drivers want to do it. It might just be because they are afraid of police or hidden cameras. [10] But that is not all. Jane McGonigal writes in her book how over time people build up tolerance to extrinsic motivators and start to want more in order to get the same level of satisfaction [3]. And if it happens that the rewards do lose their charm, one needs to come up with more appealing new and not yet boring ones. As mentioned above, people like extrinsic motivators as long as they are unexpected. Werbach stresses that we do not get pleasure from the actual rewards but from the anticipation that there is a chance to get a reward [10]. Extrinsic motivators are on one hand easy to use and find. On the other hand, they cannot be the best sort of motivators in the long perspective as their motivational value can drastically change due to predictability or the growth of tolerance.

Taking into account everything above, motivation that comes not from within the person can sometimes be profoundly demotivating. Moreover, Hamari, Koivisto and Sarasa write that extrinsic rewards can undermine intrinsic motivation [25]. As the latter is what the author of this thesis believes is a very important part of gamification, one could claim that that extrinsic motivators could negatively affect gamification as such. So, when using the gamification approach, one must be very careful when applying extrinsic motivators. It is essential to find all the possible intrinsic motivators and not rely only on extrinsic ones. But what is intrinsic motivation and how can it be generated?

Intrinsic motivation

Intrinsic motivation is defined as **wanting** to do something. This is the motivation type that makes people persist at difficult problems and eventually learn from their mistakes [24]. Intrinsic motivation is tightly connected to the notion of flow (see pg. 17) Jane McGonigal describes flow as situation where the very act of what one is doing is enough and one feels enjoyment from being fully engaged [3]. Intrinsic motivation could, if used correctly, help people enjoy boring activities [1] and can also cause person to experience flow (energized focus), enjoyment and involvement [27]. So it is the type of motivation one would like to create and that is typically part of a well-designed game. The question is- how can it be established?

The main methods to enhance intrinsic motivation are brought out in a book by Edward Vockell [30]. The five different methods are challenge, curiosity, control, competition and cooperation, and recognition. So these are the elements that should, if possible be introduced through gamification approach. Another view on intrinsic motivation is analysed by Jane McGonigal. She discusses four major categories of intrinsic motivation: satisfying work, the experience (or hope) of being successful, social connection, meaning. She writes that these four categories are the most powerful motivations next to basic survival needs [3]. So one has to enjoy the activity, see the meaning behind and feel capable of meeting the challenge. The latter is said to cause people to feel highly motivated, extremely interested, and positively engaged by stressful situations. And these are the key emotional states that correspond with overall well-being and life satisfaction [3]

4. Devise activity loops

It is important to analyse the course and try to find out what are the repetitive structures. Based on that, it is possible to create different kind of loops:

- **engagement loop** - create structure in a way that activity cycles happen (see Figure 2.), the main components are motivation, action and feedback;

Figure 2. Activity Cycle [1].

- **progression loops -** the player has to be able to evolve from beginner to master player (see Figure 3.). It is important to find or create goals that will motivate. A typical scenario for a game would be onboarding, resting phase, boss fight, resting phase, boss fight and so on until the final challenge is met. In case of education it could be smaller exercises and class work evolving to more challenging tests, to midterm test, then again classwork and exercises and then the exam as the representation of the boss fight.

Figure 3. Progression to mastery [1].

5. Do not forget the fun!

J. Dale Prince writes how poorly designed gamification often ends up missing the most important element- fun. He brings out that by forcing to play, the game loses its purpose. Games are not fun because they are games, but the fun is an element that comes with good design. [6] Zichermann and Cunningham write that judging by the state of educational software industry, the children will not learn from a game if it is not fun. They conclude that for the learning process to be effective, fun should be put even before education [2]. Thus, fun is an important aspect in gamification and the gamified system has to be designed to allow fun to happen.

It is important to find out why a player would like to perform the task and how it could be done in a more engaging way. The badges on their own are not fun at all unless they are used in a right way. Then again, images, graphics and small messages that pop out and encourage players could all add to the fun factor. A progress bar, which could help the student to follow his achievements, could be perceived as a fun feature as people like to track their progress. So fun can be triggered by many different factors.

It turns out that actually there are many different types of fun. The conducted study by XEODesign tried to find out what emotions games trigger in players and what experiences they enjoy most while they play. Even though failing is usually a very important part of

games, they found out that players still perceive 80% of the failings as fun. After thorough analysis they came out with several categories of fun:

- **hard fun**- really challenging games that players played in order to beat the game and to find out how good they really are; games that need strategy instead of just pure luck; hard fun is known for generating emotions like frustration and *fiero* (Italian, personal triumph) [12], also the flow (see pg. 17) can be reached in the hard fun where overcoming the challenges is part of fun [9];
- **easy fun**- the main focus is on getting the player attention and not winning, it targets players sense of curiosity to find out more;
- **altered states**- for many players the main motivator to play is the feeling they get while playing the game, it is a chance to move from one mental state to the other, to think and feel something different (excitement and relief);
- **people factor**- for many players, the most enjoyable part of the game is playing with others; player interaction can be the main source of enjoyment, it has been recorded that participants can even play games that they do not enjoy just to socialise with particular group of people that they enjoy; the main keywords here are social interaction and teamwork. [13]

Zichermann and Cunningham write that basically everything has the potential to be fun [2]. But there is always a decision to make. Which kind of fun to prioritize? Jane McGonigal writes that if one selects only the easy fun, one can easily end up "*from stress and anxiety straight to boredom and depression*". She believes strongly that people should avoid easy fun and concentrate on finding the hard fun that one enjoys. The concept of eustress, or positive stress is also tightly connected to hard fun. [3].

So stress is a notion that can be accompanied with fun. But the aim should not be on regular stress that makes people shut down and feel negative emotions. Instead the positive stress should be preferred. Jane McGonigal clarifies that eustress is a form of stress where person does not feel fear and the pessimism is not generated. Instead, as the stressful situation is generated on purpose, the person will feel confident and optimistic. [3] One way to generate this positive stress situation is through experiencing had fun that is challenging, but at the same time rewarding.

When talking about fun, one has to also look at the notion called flow that happens most often in games and game-like activities [29]. Flow is defined as a feeling of immersion and energized focus. Csikszentmihalyi defines flow as specific kind of happiness: "*the satisfying, exhilarating feeling of creative accomplishment and heightened functioning*" [29]. It appears when the perceived skills of a player (a student) and perceived level of challenge of the task are balanced (see Figure 4.) such that the skills are completely involved in overcoming the challenge. [9, 26]

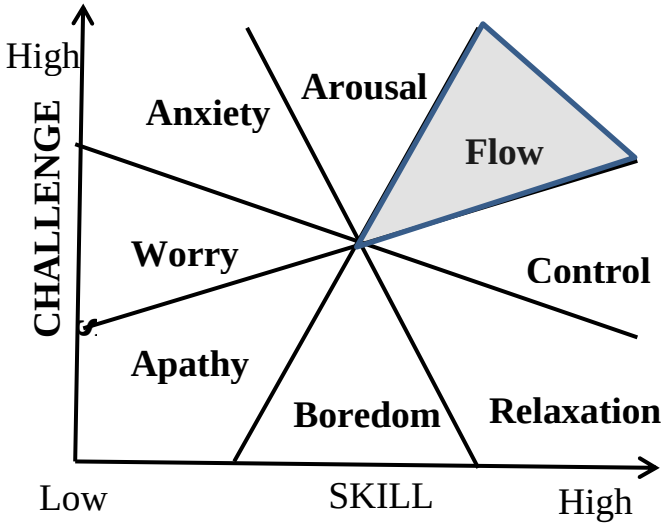

Figure 4. Flow [28].

As flow tends to appear when a person has clear goals and knows the way to respond to them, it allows one to concentrate on the task with maximal motivation [9]. Michaly Csikszentmihalyi writes in his book how flow can be generated through particular combination of set goals, personally optimized obstacles and continuous immediate feedback which allows a person to identify the level of progress. These are the same elements, that belong to the essence of the games structure. [29]

Thus, one can say that fun is a really important aspect of the gamification approach. Not only has it the ability to create interest and make the process enjoyable, but it can also be responsible for creation of positive stress and flow that are both very important game elements.

6. Deploy the appropriate tools, elements, structures

Dubois and Tamburrelli write that most elementary gamification elements are challenges or tasks and the rewarding mechanism with its rewards for the fulfilled tasks. [20] Werbach in his lecture says that people usually believe that just by throwing the game elements into the process they will gamify the whole thing. He stresses that it is not so and the elements themselves are not the game. What he actually believes is that progress bars and badges are just a starting point, the base of the pyramid. So what are the other elements that form the gamification process?

According to Werbach, there are three levels of game elements: dynamics, mechanics, and components (see Figure 5). On the top are the dynamics- the most conceptual elements that create the framing for the game. In the middle are the mechanics that make the game move forward. And at the bottom are components that are the low level elements. No gamification project will have all of these elements, but the task is to select the ones that will give the wanted result.

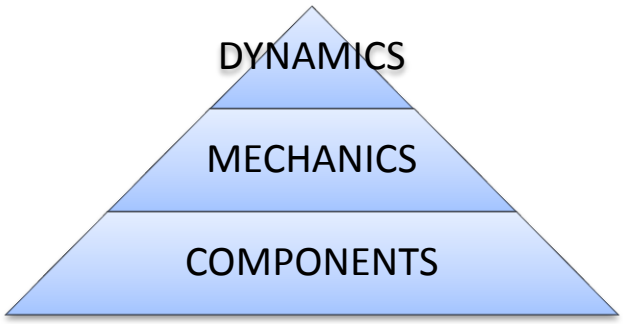

Figure 5. Different categories of game elements [1].

The main elements of these three levels are shown in Table 1 on the next page. Each of these elements could also be applied in terms of gamification of software education or education in general. Some of the elements are more hidden than the other ones, like narrative and progression. The first could mean that the course leader could select a theme that is appealing to his students and it would tie the whole course together. The second one, progression is a concept which means that there is a chance to move from one stage to another (does not necessarily mean that one has to use levels and points).

Table 1. Game elements [1].

Dynamics	**Mechanics**	**Components**
Constraints	Challenges	Achievements
Emotions	Chance	Avatars
Narrative	Competition	Badges
Progression	Cooperation	Boss fights
Relationships	Feedback	Collections
	Resource acquisition	Combat
	Rewards	Content unlocking
	Transactions	Giving
	Turns	Leaderboards
	Win states	Levels
		Points
		Quests
		Social graphs
		Teams
		Virtual goods

The most concrete elements are components. They are the ones that are usually thought to be the main gamification elements (points, badges, levels). However, it is important to think about all of the different level elements to be able to make the best selection based on the specific course analysis and gamification model to be applied.

1.6. Gamification in Practice

There have been several attempts to use the gamification process in the field of education. Some of the experiments have been claimed to be successful, some not. In a book "The Multiplayer Classroom Designing Coursework as a Game" by Lee Sheldon [5], one can find many different examples of classes that improved after the gamification approach had been selected. Lee Sheldon himself gamified a software engineering course by turning an entire class full of students into multiplayer role-playing game World of Warcraft. The task of the students was to make teams and compete. Each of them had their own avatars. The grading system was built up based on experience points. The approach was to make the

students want to upgrade, get experience and to level up just like in a computer games. The overall result was that the students were thrilled to have such a new approach in a regular school class. The course leader also admitted that it was a very enjoyable and fun experience.

The author of this thesis believes that in many positive gamification examples a very big role is played by a highly motivated course leader who managed to inspire his students. One could argue whether the success was due to gamification or the positive influence of the teacher. Another explanation could be the case of Hawthorne effect, according to which if people know that they are examined, they will try to perform better than they normally would [35].

However, there are negative examples. Werbach claims that gamification could affect education in a positive way if used correctly [10]. Followingly an experiment conducted in Germany, in The Cooperative State University of Baden Württemberg is described [9]. It is an example of a gamification of a Software Engineering course that failed. There were several gamification approaches applied to this course:

- course had a clear path,
- student could decide the speed and order of progress,
- exams could be repeated,
- progress bars, leaderboards, rewards for collaboration and acts of support were used.

The overall outcome was that the students did not receive the gamification ideas in a positive light. Students saw gamification as "*unnecessary hindrance towards studying for the exams*".

As Berkling and Thomas wrote in their article, there were several misconceptions. Firstly, gamification as such is based on an idea that students like to play computer games and most of them are gamers. What came out of their experiment was that the students in their classroom were not actually gamers (only 18% of them gamed daily and 55% played games less that once a week). Also, not many students played „hard fun". So there were very few gamers and those who played liked the "easy fun" type of games. Based on this,

the authors concluded that it was just a waste of time to use connotation of gaming in the university, which is a very outcome-focused environment.

Also self-regulation and planning did not work out as there were those that lagged far behind and did not know how to plan their time. The authors wrote that their students were just nor ready for the autonomy that they were given and did not reach mastery. All in all, the project work that the students were supposed to start seemed unattainable for many of them, and self-regulation according to which the students had the chance to organise their time themselves failed in spite of several unenforced schedules that were proposed for them by the course leaders.

The authors concluded their experiment with a suggestion that the most important changes that they would do next time when applying gamification to a course is to use the gamification elements, but "*without naming them explicitly and to introduce change from traditional style classroom to a learning environment very slowly*."

So, gamification is an approach that can work if the correct elements are selected and implemented. However, there is no rule of thumb or guarantee that even after thorough analysis the outcome will be the one that was initially planned.

1.7. Conclusion

Based on the study on the existing theoretical material on gamification, the author of this thesis has brought out some of the most essential ideas that are going to work as a starting point for the following gamification process:

- the implementation of gamification elements should be gradual and iterative, requiring several steps of evaluation and corrections;
- gamification elements should be voluntary;
- each course should be approached individually;
- class should be designed for different players, not only for those who are motivated by competition;
- visual materials like progress bars and charts are important as create sense of progression and completion;
- immediate clear feedback is very important;

- goals have to be clearly defined and interconnected into a logical progression;
- extrinsic motivators like points, badges and leaderboards should not be used to replace intrinsic regulators if the latter exist;
- fun is important, but one needs to find the balance between hard and easy fun;
- the goal should be the creation of flow through application of gamification techniques and elements without losing the main goal and values of the course;
- failing is a part of the game and should not affect students in a demotivating way (positive grading system);
- the tasks should be challenging, but not overwhelming;
- implementation of bonus tasks is essential as it creates a chance for those lagging behind to catch up;
- gamification should not always be used if the potential conflicts from the new elements and approaches will outweigh the potential benefits;
- appropriate gamification elements and techniques should be selected based on thorough analysis of the existing system and set goals.

If one asks how gamification of software engineering education is different from any other gamification process, the answer would be based on the literature discussed in this thesis- it is not. Just like any other system that is the target of gamification, it has to be thoroughly analysed to be able to select the suitable gamification elements. The same process has to be done to any other course, be it marketing, mathematics or software engineering.

2.Gamification of the Course

2.1. Course Description

After thorough consideration the course MTAT.03.130 Object-oriented Programming was chosen. It is held in both autumn and spring semesters and is made up of 32 lectures and 32 practice sessions. As written on the curriculum page, the aim of the course is to provide basic knowledge about the nature of object-oriented programming, skills for programming and primary skills of teamwork.

There are some important skills that the person taking the class should have after completion of the course. The student

- is able to define the essential concepts of object-oriented paradigm and analyse the corresponding programs;
- is able to describe different data structures and their use;
- is able to explain the value and nature of application programming interfaces (APIs) and find useful information from them;
- is able to explain the essence of event-driven programming and exception handling and exemplify their use;
- is able to design, implement, test, and debug programs in one object-oriented programming language with integrated development environment (IDE) implementing the above items;
- is able to explain the essential elements of teamwork drawing on personal experience.

In order to be able to take the exam the student currently has to collect at least 28 points from teamwork, practice sessions, tests and 6 points from lectures. In order to get a positive grade on exam, the student has to collect at least 10 points. All the tests can be retaken. Currently the points are divided as follows:

- lectures: 12 points;
- practice sessions: 12 points;
- test nr 1.: 16 points;
- test nr 2.: 12 points;

- three groupworks: accordingly 5 points, 5 points, 3 points;
- presentation of the teamwork: 3 points;
- final exam: 35 points.

2.2. Analysis

According to the gamification strategy, one needs to go through three main steps: analysis, integration and evaluation (see Section 1.4.). As the scope of this thesis is limited, only analysis and theoretical suggestions for implementation and evaluation are given.

Motivation

As discussed in the theory chapter, education is a field where gamification is and can be used. The course itself has elements that could benefit from gamification. The main ones are communication and sharing of information, creativity and development of unique skills.

Meaningful choices

The students will have exercises and additional assignments to choose from during the course. Also, the author of this thesis proposes that the gamification elements, just like a real game, could, if possible, be voluntary. Thus freedom of choice is offered.

Structure

The course has suitable structure that makes adding gamification elements possible. The subject has a set of goals and tasks of different level of difficulty. The students need to be motivated in order to participate and submit the necessary assignments and the course leader needs tools to do so.

Potential conflicts

The main potential conflict is that the course could become too goal oriented. If the main focus will be on gaining points and competing with others, it not only could be demotivating for some group of students (see Section 1.5.), but also could result in a shift in course objectives. The focus of the course, even after the gamification elements have been implemented, should be on student´s personal growth and obtaining new skills.

Below, the course is analysed based on the gamification design framework. After the analysis, under Section 2.3., gamification elements that could be used to improve the course are listed and discussed.

1. Objectives

One of the main goals of course (OOP) leader is that competition during the education process should be as minimal as possible. The focus is on personal development in a low stress environment. Another aspect is the construction of a smooth workflow which means that the students would participate throughout the whole semester and submit all the assignments on time. From the point of view of the student, the main goal is to achieve better overview of ones progress through better feedback. Also, better overview of class progression for teachers could be listed as one potential objective. In addition every course leader wishes that the students would be motivated to attend classes and be interested in the course.

The main way to measure whether the objectives are fulfilled or not could be judged based on grades, but also on the participation, submission percentage and the feedback from the participants at the end of the semester.

2. Target behaviours

The main target behaviours that ideally the students would have:

- spend more time on code review making it better (metrics: submit bug free code);
- students obtain teamwork skills (metrics: they perform teamwork, solve conflict situations);
- students communicate their troubles, questions (metrics: message board is used);
- students help to solve problems (metrics: feedback at the end of the course);
- students feel motivated to be part of the course (suggest questions etc.) (metrics: positive feedback at the end of the course);
- students submit their homework on time (metrics: number of students that do);
- students participate in classes and practice sessions (metrics: number of students that do).

3. Players

Students, as any other players, can be motivated through many different means. Some of them might be interested in competition and get motivated by constantly checking the leaderboard. However, as discussed on Section 1.5., most of them would probably find competition stressful and not motivating. For some, the main motivator could be interest in the subject and obtaining new skills, for others, just getting a good grade. According to the feedback in ÕIS, the Object-oriented Programming is one of the courses with a very good feedback. Thus, one could assume that the students taking the course are already motivated to take this subject. (The reason for this could be that it is one of the introductory courses to programming that is of high interest to many students, but also that the course itself is already structured in a very good and functioning way).

4. Activity loops

The activity structure in the course is at first the learning process (going to lectures, going through and submitting exercises, getting feedback), followed by taking a test (getting feedback), then again the learning process, the second test, again the learning process and finally having the exam. It is supposed that by the time the students reach the final exam, they have already obtained or even mastered all the skills needed for the exam. Basically the progression is from easier exercises to more challenging ones and the process is evaluated through intermediate submissions and tests.

5. Fun

One could argue that programming is fun on its own and no additional effort has to be done to create it artificially. However, it might not be so for everybody. The question here is if the course is fun enough as it is now and what could be done to make it even more enjoyable.

As discussed in the first chapter, extrinsic elements (see Section 1.5.), like progress bars and charts could be perceived as fun elements as people like to get instant feedback and track their process. During analysis of the course, it turned out that the clickers are used in the course to provide quick anonymous feedback in lectures. Also, teamwork, that is also implemented, could be perceived as something fun, especially for those students who are motivated by social interaction.

So far, the topics of the assignments are quite neutral, ranging from typical math assignments to day to day problems. The author of this thesis believes that one way to add to the fun factor could be to find the theme that the students would be interested in or amused by. However, it might turn out to be a challenging task, as all the students have very different opinions on what is interesting. The course leader has actually used the method where one has the free choice of deciding on the topic of the group work. Thus, the student can select the theme he/she is interested in.

6. Appropriate tools

All the possible tools listed in Section 1.5. were evaluated and the most appropriate ones that could be used during the gamification process were selected. The most suitable ones that the author of this thesis considered applying to the OOP course were from dynamics: narrative, progression, relationships; from mechanics: challenges, cooperation, feedback; and finally from the components: achievements, boss fight, collections, content unlocking, giving, teams. The selection was based on the nature of the course, its main objective and its theoretical subject material. All of them either match the course objective or could add value to the subject. Once the elements had been selected, the next step was to identify the ones already in use. As the course itself has been held for quite some years, it was interesting to find out what kind of gamification tools and elements were already used without calling them gamification elements. It turned out that there were quite a few of them.

Gamification elements and methods already used:

- challenges in the form of tests and tasks (combats and boss fight);
- all the test, can be retaken (final grade counts) so that failing is less stressful and could not be perceived as a catastrophe;
- cooperation- teamwork is part of the practice sessions;
- progression form easier tasks to more challenging ones;
- students can choose their own tempo at the practice sessions (selection of exercises are given, can select the ones they want to do, in their own pace);
- immediate feedback during lectures (clickers), personal feedback in the practice sessions;
- rewards- bonus tasks for extra points (e.g. analyse your test and fix the mistakes to get 1 point);

- choose the topic of your project (student can create his/her own assignment);
- clear course structure and tasks (homework, practice session assignments tests, exam).

The new gamification elements that are proposed by the author of this thesis can be found in the following section.

2.3. Suggestions

New gamification elements that are proposed for addition to the course:

1. information exchange environment (giving);
2. personal progress charts (feedback);
3. progress bar – to track what assignments have been completed, how many points, what assignments are remaining (feedback, clear goals);
4. work time tracker (feedback);
5. after the student has finished some of the assignments or collected enough points, he/she is allowed to do some extra assignments (content unlocking);
6. more visually appealing and structured materials- plain text would be replaced by structured separate slides with marked keywords, that would allow more clarity and better overview;
7. extra assignments to gain extra points: additional points for smooth workflow (all assignments done in time, no retakes done), contribution to lectures or practice sessions, additional reports, tutorials.

Most of these elements could be implemented as a virtual environment where students could exchange information, see their personal progress charts and course progress bar and have access to additional tasks and assignments. As it is an additional programme that should be running during the practice sessions, it should be as light weight and unnoticeable as possible. The idea would be to create an environment that is very laconic and intuitive. There would be no long explanations or menus, just pictograms, so that it would be easy to grasp what is needed. Rough sketch of the main layout is shown on Figure 6.

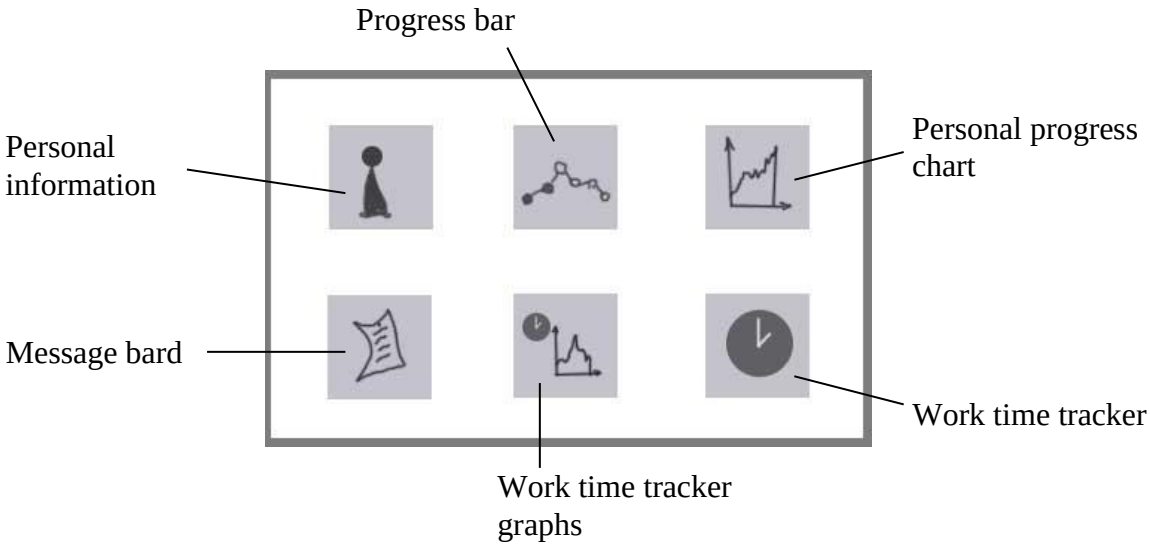

Figure 6. Main layout of the system.

The main goal is to create a system that would be designed according to the gamification rules. Unlike Moodle, that has a lot of functions and information, most of it in the text format, the proposed system should be laconic and pictogram oriented. It is said that graphics, background colours and textures should be kept simple [32] when good design is the goal. It is also known that comprehension of information can be enhanced through using non-linguistic transmission [33] e.g. pictures or videos. It is especially important as human attention span is a limited resource [34] and through minimising the amount of information it is possible to enhance the readability of the site. Through these concepts it is potentially possible to achieve an environment that is self-explanatory and easy to work with which are some of the key ideas of gamification approach [10].

One of the main ideas is knowledge and information sharing that currently happens mainly during the practice sessions. To make the communication more continuous throughout the whole course, the author of this thesis believes that there is a need for an environment where one could ask questions, communicate their experience and help to answer the questions. The proposed system will incorporate all of these functions and also will have a feature that will allow voting for the most essential posts. Unlike the existing systems that are rather static, the idea is to have more interactive approach. Here a pop-up screen idea is introduced to gather and share information during out of class time. The principal is that the course leader can insert a question into the system and pop-up screen (see Figure 7.) will appear on students' computer screens once they have turned on the environment. The pop-up screen system could also be used to send motivational texts to students. It is a feature that could have a lot of motivation potential, but is lacking in Moodle which is mainly

used for official announcements. The pop-up screens could be also pre-recorded and would be triggered once a certain event happens. One example is, that if the student has finished his/her exercise, a screen would appear with a message “Good work! You are 3 assignments away from mastering this subject ☺”.

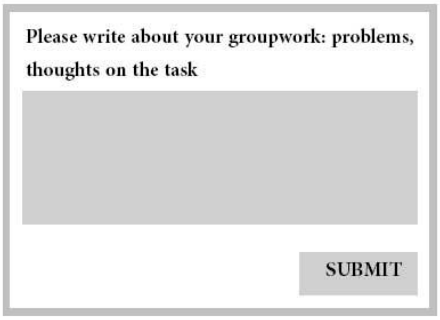

Figure 7. Pop-up screen.

In case of a query made by the teacher, the student can type his response into the message box and press the “submit” button. After that he can see all the other answers given by his classmates that are categorised into pre-selected groups (categories are created by the course leader). The message board with categorised answers can be seen in Figure 8.

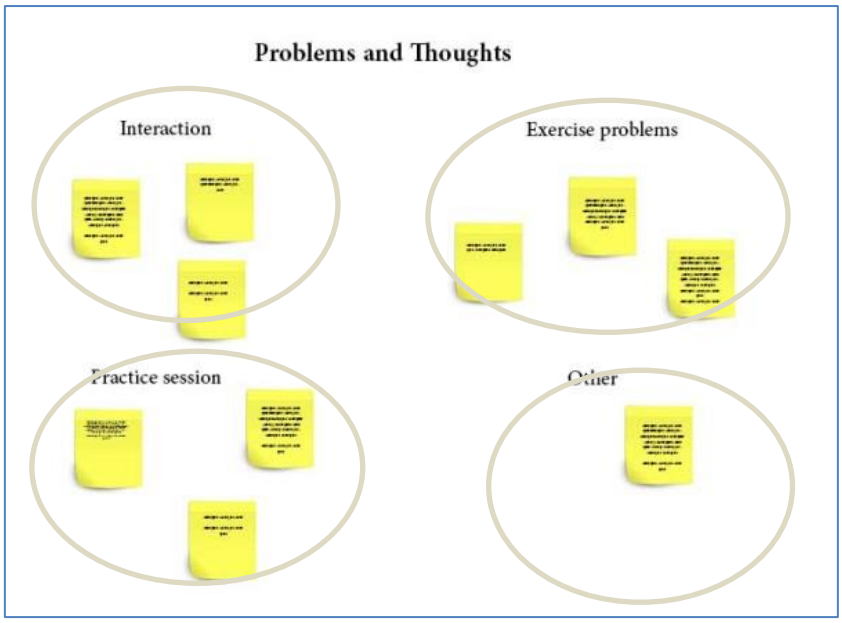

Figure 8. Message board.

Also, the students will be able to vote for the best reply, or for the one he/she thinks is most relevant. There will also be a chance to comment on answers given by other students.

The answers will appear in order that is determined by the number of votes it has collected. Illustrative sketch of the voting system and answering possibilities is shown in Figure 9.

Figure 9.Voting system on idea sheet.

One of the course objectives is to develop skills in programming and the target behaviour is to motivate students to spend time on code review. However, the current system has no features for one to be able to measure the progress. The author of this thesis proposes potentially an attractive program feature that would allow time tracking while doing homework or writing the code. Ideally it would also draw out charts communicating the accumulated information in a clear way that would allow the student to get new kind of feedback for ones work and by that, motivate the process.

The system would also have the course progress bar (see Figure 10.) feature that would allow progress and points tracking. Unlike Moodle, where all the points are in number format, the proposed system would use graphs that will give better overview of the process. Different level assignments will be all marked in different way, thus making it easy to understand how many hard or easier tasks are ahead and how many have been already done.

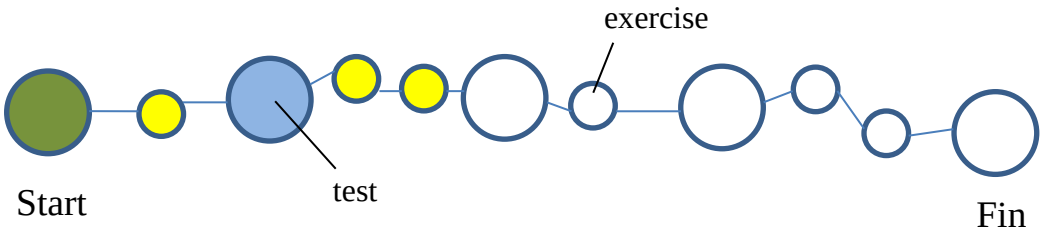

Figure 10. Course Progress Bar.

Also the proposed system would allow the student to be able to see his personal progress chart (see Figure 11.). The latter will display current progress, class average and the predicted grade he/she will get with the same amount of effort. One idea is also that it could suggest additional assignments or retakes if the inserted target grade is unreachable with the current trend. The extra assignments would have to be added by the course leader. One idea is that the teachers could also see the general progress of the class, but without any personal identification.

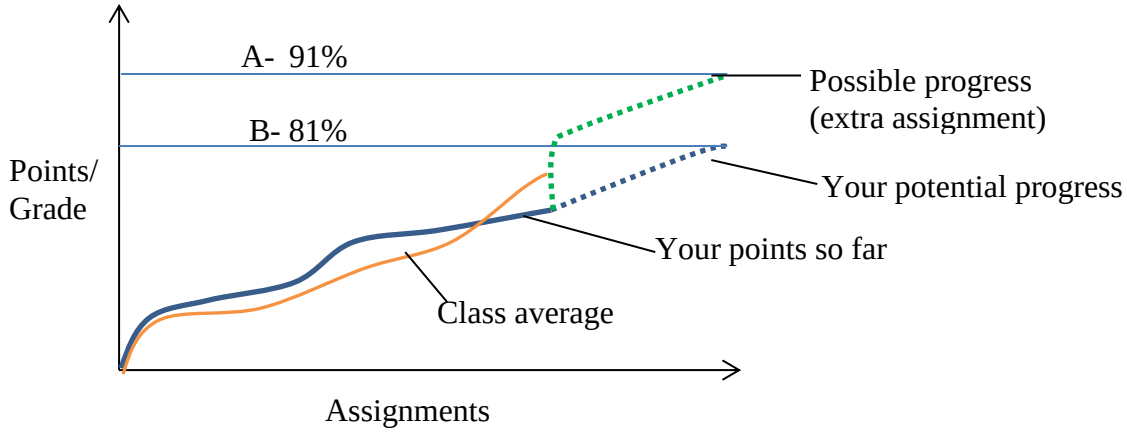

Figure 11. Personal Progress Chart.

The scenario of a potential future practice session would be as follows. The student turns on the computer and the virtual environment. The student logs in using password and user name. If there are any notifications, they will pop up on the screen. The student can look at the message board and personal charts. The environment´s visually seen screen can be closed, but the system will remain active. The student can open the system any time. In case the class leader wants the groups/students to answer some questions, a pop-up will appear. Otherwise, the environment is running as a background process and the student can concentrate on working on his/her assignments. If one wants to measure the time spent on task, one can open the system and start the work tracking function that will fix the time used for coding or any other event defined by the user. Eventually, based on the inserted information, work time graphs are generated for a better overview.

2.4. Discussion on the Proposal

Alienation

One of the suggestions of this thesis is to create a virtual environment that would allow progress tracking and exchange of information. One of the negative aspects that such envi-

ronments might have is the alienation of the students from real discussions that are an essential part of the education. On one hand, one could say that the virtual environment could help those not brave enough to be part of discussion and ask questions. On the other hand, if they never have to do it in real life, they will never acquire skills for it. However, the author of this thesis believes that the positive effect that will come out of discussions over problems and task solutions will outweigh the negative effect the system might have. Also, the essence of the discussion board is very similar to the StackOverflow environment [http://stackoverflow.com/] which is used basically by every programmer. The new system would help the students to become more used to the structure, thus allowing them to feel comfortable using similar communication and information exchange environments in their future work.

Designing the System

The key idea is that all the gamification elements would be voluntary**,** thus the students themselves could choose whether to use them or not. One aspect of choosing this approach is that the system might be left unused as the students might decide to avoid it. The question here is: "how to make the players play and keep them playing?" In other words, how to make students want to start using the system and how to keep them wanting to actively use it throughout the course. It means that the process of design is of crucial importance. One has to think about the features to be appealing, user friendly and beneficial for the end user (i.e. students). Visual appeal could be the starting point for students to decide to open the additional system, but also the course leader can be the person to initiate the process. The latter can be done through introducing the program and its beneficial features to the class. There is another negative aspect to be considered. Namely additional work for the teaching personnel who have to do extra work throughout the integration process and the whole semester to keep the system up to date.

Other Alternatives

Another aspect to be considered is that the students might already have some other alternative media (Facebook, Skype) that they are using or that they will decide to use instead of the one offered to them. One could also ask why this system could be a better solution than for example Moodle environment that is used today. One of the assets of the new system is that unlike Facebook and Moodle, it will be stripped of unnecessary functions and information. It will be more lightweight so that needed information will be found easily. An-

other positive aspect is that communication will be the main function of the system. According to the current (23.04.2014) information flow in Moodle, it is not functioning as a successful information exchange environment to the course. The reason could be that it is just not attractive enough, but also the author of this thesis strongly believes it has to do with the fact that the environment feels too controlled and formal looking. Currently Moodle is mainly used for assignment upload, and the information exchange function is secondary. Another aspect is that Moodle is very static in a way that it lacks interaction part that the new environment would have with its pop-up screens that could potentially act as a more engaging way of obtaining and sharing information. All in all, there is no guarantee that the new system will be successful. What can be done is to make the new environment as convenient and as user friendly as possible. The latter can be achieved through clarity and function orientation.

Pop-up Windows

As mentioned above, one of the features of the programme is pop-up notification or question windows. The positive side is that this way of communication could be perceived as more engaging and fun. However, there downside is that it might be seen as something distracting and in time become too imposing. Also, the system cannot interact with the student unless it is turned on.

Anonymity

There is also question of anonymity. On one hand, being anonymous gives more freedom and those worried to ask "silly" questions might get over the emotional barrier. On the other hand, anonymity contributes to dissipation of social ties as nobody knows who is actually the other person asking the questions or giving an answer. There is also an argument that school should be the place where one will learn to take responsibility for ones thoughts. However, as the aim of the system is being as welcoming and as unrestricted as possible, the author of this thesis believes that, like in a game where player can feel free, the system should be anonymous to some extent for it to function properly. One idea would be to let the person posting the question be anonymous while those who give the answers would be identified by names which could help to eliminate malicious answers.

Points and Assignments

There is also a question if extra assignments and virtual environment points be motivational enough. Especially the latter ones if they will not count in formation of the final grade, but only allow to unlock extra assignments. Also progress tracking could affect some of the students in a negative way as there is always a chance that a particular group of users will concentrate too much on gaining the points instead of focusing on the assignments and on obtaining new skills. However, the author of this thesis believes that the approach where not all of the additional assignments are available at once, but some can be accessed only after some effort, could act for some of the students as a motivator to gain points, access the assignment and finish it. The method could work especially if the unlocked assignment is less complicated than the usual ones. It could be for example a review of one's previous mistakes or analysis of one's progress. At the same time it would give the same amount of points as the regular task. This way it would be possible to make the unlocking process more motivating, as it would actually make life easier for the students.

Alternatives for the Proposed System

One of the propositions is to make a virtual system that would incorporate most of the other gamification elements. One could ask, if it could be done in another way. The author of this thesis believes that it is possible to apply all the gamification elements without the virtual environment. For example, the personal progression charts could be substituted to general progression charts and sent via email to the students. Each on the participant would find ones location on the cart based on the points they have earned so far. It would be in a way anonymous, as the chart sent would be overall and could also involve suggestions for extra tasks if the needed amount of points is not reached. Similar approach has actually already been used by Margus Niitsoo in University of Tartu, during course called Introduction to Informatics (2012/2013). Every Monday he generated charts showing how much time was spent on studies and uploaded them based on the information he had received from the students. The only identification element was matriculation number, thus allowing each student to find himself on the chart. Also there is a solution for information exchange that could be done in an interactive way through Google Document. The latter would allow students to type simultaneously their thoughts on the assignment and give advice.

The Potential Outcome

Finally, one could ask if all these elements might not always produce the wanted outcome then why one should implement them at all. The author of this thesis believes that the positive effect gained from the changes could potentially outweigh the negative aspects. So what could be these positive changes? In which way the new elements would make the course better? The aim was to create course where the students in a low stress environment could concentrate on their personal development. The author of this thesis believes that by creating an environment that is easy to handle and welcoming, the students will have a new opportunity to engage more with the course and deepen their knowledge on the subject through a different sort of feedback and constant discussions. Also, the progress tracking feature could not only be interesting for the students to look at but would also give more control over the progress and offer extra resources to tackle the weak points and ensure better time planning.

The new system could be seen as an additional motivation system that will give crucially important feedback and motivate through displaying positive messages and suggestions for improvement. The goal of the process was to focus on intrinsic motivators rather than extrinsic ones. The latter is achieved through creating control (progress tracking, personal progress charts, clear cause and effect scheme), enhancing cooperation (pop-up screens and message board) and giving opportunities to gain recognition (voting for best answers, ideas) from other class members that the current systems are lacking.

2.5. Suggestions for Implementation and Evaluation

As discussed on previously, there is no magical recipe for turning regular course into gamified course. The same applies to OOP. All the suggested new elements should be implemented gradually. Ideally, the students would be part of the modification and implementation process. It would also mean that they could suggest modifications and contribute to the process. In case the virtual environment is created, there is also a need for introductory lesson so that the students would be familiar to the system and would know about all its benefits.

After the implementation is over, it is important to gather information and feedback from the system and the students on the outcome. It is essential to find out how many students

have used the new system, which features they use the most and what are the main problems concerning the new environment. One should also check whether the homework submission rates and test results have improved and how the students themselves evaluate the class in general. The evaluation process will give feedback based on which it will be possible to make changes and adjustments in order to make the course even better. For example, it might be that anonymity of the system is not the best option and changes have to be done accordingly. As mentioned several times before, the gamification process is not a onetime effort, rather it is iteration through modifications, testing and remodelling processes.

3. Preliminary Evaluation

3.1. Interview

The preliminary evaluation is based on the interview conducted with OOP course leader Eno Tõnisson. After some consideration, unstructured interview type was selected as it was essential on one hand, that the course leader would get the chance to ask questions on the proposal and on the other hand, the main aim was to get his opinion on the previously agreed subject. Thus the most flexible form of interview was selected. The interview was carried out in Estonian and lasted for 50 minutes. The main outcome of the interview that has been translated into English can be seen in the next section. The audio file of the interview can be found in the Appendix 1.

3.2. Summary of the Interview

The main concern of the course leader was that the potential new system will bring **additional work** for him and other teachers as there are about 250 students taking the class each semester. However, he believes that the virtual system proposed could work if all the information is inserted into database only once and it would just spread into other systems. Also, as the system will be used during programming course, it has to be credible. It means that there has to be a lot of work put into it (for example, to protect anonymity of the users, there has to be no way to find out who the person is). The topic of concern was also the flexibility of the system. As the idea is that after the process of implementation and initial evaluation changes if needed have to be carried out. There is a concern that the system might turn out to be too complex. However, Eno Tõnisson believes that if it would be reliable and flexible enough, he personally would have nothing against such a system if the students would like to use it.

On the subject of the **existing systems** being improved instead of making a new one, Eno Tõnisson thought that maybe students would use Moodle for information exchange if there would be additional points for using it. So one of his thoughts was that maybe the ideas proposed could be implemented into the existing systems.

He had nothing against the idea that the students will be able to see **graphical materials** on their progress. He agreed that there are many different students and some of them might be more visual thinkers and in that case the graphically represented information would be

more suitable for them. He thought that if it would help students, it would be great. Also, it turned out that the **existing materials** of the course have been recently updated as the author of this thesis had envisioned (the changes were not triggered by this thesis). Eno Tõnisson also added that the students have admitted that they really like the improvements and see it as a positive change.

He believes there are two sides to **anonymity.** On one hand he also sees that when people use klickers, they are not afraid to ask and vote, as they are anonymous. On the other hand, there is a risk that some of the students might take advantage of it (e.g. unsubstantiated criticism towards teachers and the course).

He agreed that there might be room for **extra assignments**. He found quite interesting the idea of tasks that would unlock under certain conditions. Eno Tõnisson agreed that maybe that would actually motivate some of the students to make the extra effort to get to the task and finish it with more enthusiasm. However, as there are very many students, it has to be carefully planned. He stressed the importance of personal feedback that has to be given for each assignment. On the topic of alienation of the students, he did not see it as a severe issue in his class. However, he stressed that during practice sessions he sees that personal contact is what works the best. In that sense, he thought that pop-up windows that would allow to get information from students during project work, that is carried out outside of school, is an applicable idea.

The biggest potential he sees in the **work time tracker** that he found to be simple (could be easily realised and implemented) but interesting application. He thought about maybe even giving extra points to students for using it and analysing the results in the end. He believes that time measurement is really important in software development. He also suggested that maybe the time tracker could incorporate a list of pre-written activities to choose from.

Eno Tõnisson concludes that he has nothing against the suggestions as long as they would not mean drastic additional work for the teaching staff. The most potential he saw in the time tracker that could be easily done and implemented and that could give valuable information to the students that they do not have at the moment. The one concern still re-

mains- there are more than one teacher running this course and as all of them have to agree to changes, he was a bit worried that finding a consensus can become a challenge.

Conclusion

Gamification is a notion that can be interpreted in many different ways. The most broadly used definition for gamification is that it is the use of game elements and game-design techniques in non-game context. It is an approach that is broadly used not only in business, but also in education. Even though there is no recipe for gamification there are three steps that have to be undertaken during the process: analysis, application and evaluation. During analysis it is essential to analyse the system according to the gamification design framework. The important thing is that even after thorough analysis and careful selection of gamification methods and elements, there is no guarantee that the approach will give expected results. Gamification is definitely a process where iteration through analysis, implementation, evaluation and modifications usually has to be undertaken several times. More importantly, gamification is an approach that sometimes might lead to negative results, thus it is not always applicable.

When it comes to education then gamification has often given positive results. However, not all examples are successful. While using gamification in education, the most essential is to keep in mind the main goal of the course and not be tempted to rely completely on badges, leaderboards and points as these elements in some context might act in a demotivating way. The main idea for the author of this thesis is that there is no difference whether to gamify a math class or software engineering education. The key to the success is still in the analysis, selection of the right type of approach and suitable motivation techniques.

The discussed approach was applied to design a gamified version of the Object-oriented Programming course. The author of this thesis found during analysis phase that there are already used elements and approaches that can be classified as gamification. Several new suggestions were made based on the course objectives. The main focus during gamification process was to use intrinsic motivators rather than extrinsic ones. The latter were attempted to generate through creating control (progress tracking, personal progress charts, clear cause and effect scheme), enhancing cooperation (pop-up screens and message board) and giving opportunities to gain recognition (voting for best answers, ideas) from other class members. The propositions were discussed with the course leader who found the most applicable and useful is the work time tracker idea which not only could be perceived as a fun application but could give some very valuable feedback to the students.

To sum up, the concept of gamification was selected due to its novelty and appealing image. The notion itself was completely unknown to the author of this thesis in the first place and thus it was quite challenging to gain enough insight to be able to apply the approach in a proper way. However, even though the process was time consuming, it was very interesting and educational. As a result, the main outcome of this thesis is:

1) firstly, summarising theoretical material on gamification for education, among it a set of guidelines for undertaking the approach is drawn out;
2) secondly, gamification of a course based on the previously analysed materials, discussion of the proposal, and preliminary assessment of the suggestions by the course leader.

As the scope of this thesis was limited, and only theoretical gamification suggestions were made, the next step would be to test out the approach in practice.

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Appendix

Appendix 1

Audio recording of the interview with Eno Tõnisson.

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