The use of game elements for increased motivation in game based learning

Motivational triggers and important factors to consider when designing learning games

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ABSTRACT

This research paper focus on how games can give the learner increased intrinsic and extrinsic motivation. In particular, we have evaluated how these motivational factors can contribute in a learning situation, and how education can benefit from games. Based on the literature reviewed, a matrix is presented that shows how these features can contribute in a learning situation, and which factors that is critical for learning to occur.

KEYWORDS: games, educational games, interactive learning, motivation, game based learning

1. INTRODUCTION

In recent years, there has been an interest for educators and researchers to explore elements from games or use games in an educational context. The underlying thought is that games can provide a more engaging and fun learning experience. Many students are bored and unmotivated in class, but can be extremely motivated to learn how to perform well in a game. Such activity indicates that there has to be some elements in games that provoke the students’ desire and motivation to perform well at a high level. So what are those elements, and is it possible to find those elements and combine games and learning? Will it make educational learning more fun and engaging? This question is not simple, and there is not yet a complete understanding of the motivational factors related to games and learning. Many authors have also questioned the learning effect of games, and raised questions regarding the learning outcome when games are involved. Anyhow, it has been proven that games can increase student motivation and engagement when learning. This motivation, as described later, depends on the way the learning content is integrated in the game mechanics and gameplay.

The article is an examination of two questions. First, what are the characteristics of games that make them motivational and fun? Second, how can these characteristics contribute in learning, and what are the important factors when games and learning theory are combined? The research on games and learning has mainly focused on the learning effects of games in education or the “fun” part of games that leads to flow and motivation. This verifies that education can benefit from games, and that games may be used to make learning more fun. However, few suggestions have been made to identify a wide perspective of how different motivational characteristics and elements from games can be used intertwined with learning objectives in an educational setting. The aim of this article is to investigate how games can contribute in a learning context and which elements to consider in instructional game design. In order to find this out, we first have to
find the elements in games that give increased motivation and engagement. Furthermore, we need to find out how these characteristics can be used together with instructional material. The goal of this paper is to provide guidelines for designers who are considering interactive learning solutions, and to find out how learning content should be implemented in the game.

2. TODAY'S LEARNER

In order to evaluate the potentials of game-based learning is it essential to be aware of the characteristics of today’s learners and their environment. Today’s learner has been described as students that spend significant time exploring and multitasking through interactive environments [46]. For many young people today, the Internet and mobile phones have been part of their learning since early childhood. There is reason to believe that today’s students look upon technology as an integral part of life and a tool to immerse themselves in specific topics of interest, whenever they want. They are seeking knowledge and information based on their own curiosity and cognitive needs, and consequently control their own learning and surroundings. There is reason to believe that this new way of learning is fostered by the explorative and multitasking nature of interactive activities [46]. Further, it has been pointed out that the features of the new generation students require new ways of learning [49], and if educational learning tools and technology won’t respond to the needs of the new generation, it may result in unmotivated learners. Hence there is a need to offer a variety of different knowledge presentations for these learners and to create opportunities to apply this knowledge within a virtual world, thus supporting the learning process [1]. Emerging types of learning tools that have opportunities to respond to this need are games. They make learning meaningful by creating a learning culture that is more in correspondence with the new generation’s interest [47] [48].

3. GAMES AS A LEARNING TOOL?

Jesse Schell defines a game this way: “A problem solving activity approached with a playful attitude” [41]. Many games involve some kind of problem solving, which makes them interesting as a learning tool [5] [53]. According to researchers in the field of game-based learning, games are well suited in education due to this. [11] Games have a great potential as a learning tool because they are using play that motivates the students through problem solving. [1] They create a safe and closed space where you learn what is needed to solve problems and challenges brought by the game. Game-based learning is using game mechanics and a contextualized problem solving learning process found in games in order to fulfill specific learning purposes [50]. These problem-solving tasks vary and depend on the game design, but whatever the problem-solving task is (challenges, puzzles, strategy), these tasks are the only thing that are standing between the player and the goal of the game [51]. The player must in other terms learn to overcome and solve problems to win the game. This factor makes it clear that there are possibilities of implementing problem-solving activities in the game that are related to curriculum and learning theory [5].

4. THE MOTIVATED LEARNER

4.1 The motivated learner

In order to find out how games can foster engagement and motivation through play, we first have to look at the characteristics of the motivated learner. It is shown that motivated learners focus on developing, understanding and mastering knowledge. [45]. They are enthusiastic, optimistic and they take pleasure in academic tasks and are proud over their achievements [11]. They also possess more creativity problem solving skills and enjoy learning activities more [19].
4.2 Intrinsic and extrinsic motivation

Learners may be motivated through intrinsic or extrinsic motivation. Intrinsic motivation is dependent on factors that are internal in origin, while extrinsic motivation originates from factors outside of the individual. [19] Intrinsic motivation is usually derived from feelings of satisfaction and fulfillment, not from external rewards. Extrinsic motivation is derived from rewards and stimuli provoked by outside factors [45].

5. MOTIVATION AND GAMES

Generally, it is stated that games satisfy the basic requirements of learning environments and can provide a motivated environment for learning [6]. To grasp what elements from games that give motivation and what this can offer in a learning context, we need to find the elements or mechanics of games that are interesting for educational and motivational purposes, both intrinsic motivational factors and extrinsic motivational factors.

6. INTRINSIC MOTIVATIONAL FACTORS

Motivational researchers have offered the following characteristics common to all intrinsically motivating learning environments: optimal challenge, fantasy, curiosity and user control [54] [55] [45]. If we compare these factors with game characteristics described in the literature [6], games are a medium that closest matches those characteristics.

6.1 Flow and optimal challenge

The aim of an educational game is to provide students with challenges related to the main task so that flow experience makes the learning fun, and to implement learning goals that don’t ruin the flow feeling of the game [38]. An important part of learning theory is about the relationship between the learner and the learning goals. These principles are taken a step further by the often-cited theory of “flow”. In short, a state of flow is characterized by an “optimal experience” when challenges are closely matched with the users skills and competences. [56]. The flow state is considered very attractive in education, since the conditions for learning seem to be optimal when one is in “flow” [11]. The flow state is characterized by losing sense of time and space, total concentration and awareness. Intrinsic motivation and optimal challenge is maximized in users when there is a cognitive mismatch between the knowledge of the user and the demands of the instructional environment. In other words, the task should not be too simple or too difficult with respect to the learner’s already existing knowledge [45]. Research has shown that optimal challenge is correlated to intrinsic motivation and the desire to foster creativity and efficiency [30]. Playing games gives intrinsic motivation because it gives the player optimal challenges that are closely linked to flow, and it is stated that the flow experience leads to increased learning [38].

6.2 Curiosity

Curiosity is a state that makes humans want to learn about new things that are unexplained or unexpected. To make a game intrinsically motivating, it has been suggested that if the game can build upon the natural curiosity of learners, it can provide a deep intrinsic motivation to learn the subject better [55]. A game can have two types of curiosity according sensory curiosity and cognitive curiosity [40]. Sensory curiosity is attention- attracting value like blinking light, sounds or other sensory stimuli. Cognitive curiosity in games is evoked by the desire to know more, and to complete the already known knowledge. Cognitive curiosity is consequently triggered when there is a gap between existing information and unknown information, in other words: the inability to
predict the future. Further, an environment that provokes curiosity will be one where the learner knows enough to have expectations about what will happen, but these expectations are sometimes not met [57]. This makes the user intrinsically motivated to fill the gaps and to locate discrepancies in the information. When designing a game, this curiosity can be evoked by implementing elements of surprise, novelty, complexity, inconsistency and incomplete information [11] [54]. A common way of evoking this is to make the outcome of the game uncertain, so that there is a curiosity regarding the result or how the game will develop. This can be done by allowing the player choose the difficulty-level, or letting the game adjust automatically depending on how well the player does the task. Another way of triggering curiosity is by placing information that is hidden and slowly gets revealed for the player, or by letting the outcome be uncertain depending on the opponent’s skill (like in chess). Another way is to introduce randomness. Many gambling games, like poker, are based on this principle.

6.3 Fantasy

Adventure games use intrinsic motivation of the player to explore the game world. Intrinsically motivating games incorporate learning activities in their game world, and an example of this is that the game offers a mystery or a story. The player then needs to solve the mystery by problem solving. In each case the problems are part of the game and players are motivated to seek knowledge to provide a solution in order to progress in the game. This makes the player intrinsically motivated [1]

Many games have context or a theme that makes the problem-solving task meaningful, and graspable for a deeper understanding. [35] This somehow seems to be forgotten in many classrooms, where knowledge and skills are separated from their real context. When students learn mathematics, chemistry or physics, this is often done in a more or less isolated world where abstract phenomena are not linked to the concrete application of the tool. Said in other words, learning is very difficult if the learner is unable to see the purpose and different uses of the learning material. If the student thinks the learning theory is boring, games have the opportunity to link this theory to a game world that makes the learning material more exciting. Games presents the player with challenges, they frame these challenges within a clear context, where advanced problem solving suddenly makes more sense. Using games in a learning situation is an opportunity for the learner to associate theory with “real life” use and practical application [36]. Fantasy provide the player with a safe zone, a playground where it is possible to explore and interact with the world; learning and solving problems without have to constantly fear the consequences of his/her actions. [51]. In addition to allowing the user to interact without fear of real life consequences, it also provides a strong sense of presence in the game world, which can give a highly immersive experience [25]. The player can feel directly embedded in the virtual environment and in the story that unfolds. [20]

Fantasy contexts can be endogenous or exogenous to the game content [18]. An exogenous fantasy is laid on top of a learning context, like learning fractioning by sliding a fish monster in a water world. This type of learning can be more fun than reading about pages in a book. However, a fantasy like this is external and separate to the learning context. In contrast, a exogenous fantasy is linked to the learning content. This could for example be that students learn about physics by guiding a spaceship to a planet in the universe. It has been stated that endogenous fantasies are more effective motivational tools because they are more tied to the learning content. If the fantasy is interesting, the students find the learning content more interesting. Consequently, endogenous fantasies are more effective learning motivational tools in game based learning. [11]
6.4 User control

Games are interactive; this means that in response to the users actions, the game presents choices depending on where the player is in the game. [25]. By following different choices, the user can accordingly control or change the outcome of the game [17]. Furthermore, it is noted that a variety of choices can allow the user to make the story and outcome personalized. [44]. An example of this is the game Spore, where the open-ended gameplay allows the player to develop a species from a microscopic organism to its evolution into a complex animal through different phases. The outcome of one phase directly affects the initial state of the next stage. The user is given considerable freedom and control in shaping the environment and the direction of the game. Games such as Final fantasy and Zelda place players in the role of a fictional character and provide a wide range of choices over goals, strategies, missions and skills. These games offer multiple routes to the end depending on what mission they choose, the skills they possess and the appearance of the character. This results in the player being allowed to shape the games narrative, which gives a strong internal intrinsic motivation to explore the game world. [11] [43] [44] [55]. So, by letting the player manage the direction of the activity and influence the outcome of the game, this evokes engagement and intrinsic motivation.

So, if learning is a desired outcome or side effect of a game, high level of control can be used to give intrinsic motivation and positive attitudes towards the learning experience [31]. By designing the game so that the learner has fundamental control of the learning environment and the direction of learning, the learning theory can be presented as more exiting [9]. One way of doing this is by letting the learner decide how to navigate through the content, or by testing diverse strategies.

7. EXTRINSIC MOTIVATION

It is stated that games can make learning content more fun and interesting by using extrinsic motivation factors such as rewards, frequent feedback, progress bars, sounds, points and high scores etc. [58]. By doing so, it is possible to use extrinsic motivational factors in a way that the learning theory is presented in a more challenging and fun way. In other words, if the learning goals themselves are boring, extrinsic motivational factors in a game can be used to spice the learning goals up. There are two extrinsic motivation factors that can, in addition to make the learning content more fun, give intrinsic motivation: Rewards and feedback.

7.1 Instant feedback

Feedback is critical to support performance and motivation [29]. Instant and frequent feedback in games is a confirmation that the player is progressing towards achieving the goals of the game. This motivates the user to focus the attention on the task and to provide a greater effort in reaching the goals. [25]

Learning can be hard if you don’t know if you are doing it right or wrong. Often students are frustrated if they are left alone with a difficult problem, and the teacher doesn’t have the time for guidance. Games, on the other hand, are very good at giving feedback. When doing a problem-solving task within a game, the mechanics of the game can support the player whether he/she is doing the right thing or not. Feedback occurs when there is a change in the game as a result of the player’s actions [25]. This is essential in learning, because it is critical that the player sees the connection between their actions and the outcomes [25]. Feedback informs the user of their progress in the game and whether their actions were positive or negative. [27]. Based on the feedback, the player can learn from their actions and improve their performance on their next try.

It has been shown that positive feedback gives a higher level of self-confidence. [25] Learners who
have a poor self-confidence in task engagement, who believe their competency is low, are all likely to possess poor levels of intrinsic motivation.

7.2 Rewards

It is stated that rewards can be used to strengthen intrinsic motivation, since rewards can build up the person’s self-esteem and the feeling of mastery. Rewards like badges, stars, sounds (example: clapping in the game Guitar hero), or other rewards to the players actions can make the player feel success and thus more optimistic towards own progress. This type of extrinsic motivation, such as rewards and punishment, undermine intrinsic motivation. [15] [19] [43]. Although extrinsic rewards can be less effective than intrinsic motives, both intrinsic and extrinsic motives play a role in determining learning motivation [11].

8. POTENTIALS FOR GAME BASED LEARNING IN EDUCATIONAL SETTINGS

As we have seen, games have aspects that can strengthen the motivation of the learner. Games can provide a learning activity that are motivating both because the activity itself can be interesting (intrinsic motivational factors) and because the outcome is important (extrinsic motivational factors). Now, we shall examine what the literature has stated on the potential of games in a learning environment.

There have been distinguished three potential uses of games in school environment: general cognitive abilities and skills, motivational aspects and content-related learning [61]. The strongest empirical support is for the claim that games improve affective and motivational aspect, whereas the claim that games enhance content related learning has mixed support [32]. Anyhow, we notice that educational researchers have proposed that games can be used as a math-learning tool to boost motivation and to learn math in context [59]. It has been argued that the student’s difficulty of understanding scientific concepts can be confronted using learning games [7]. Math and science are especially pointed out as suitable, because of the high level of complexity and the level of abstraction. [10] Since the nature of these subjects makes it especially difficult to understand, it has been suggested that the contextualization and fantasy world the game present to the player can contribute to improvements in science learning by linking the theory to a context of use. [60]. The point here is that it is possible to simulate a situation in which the theory might actually be used.

8.1 Developing problem solving skills

Another cognitive ability that games can contribute to is developing problem-solving skills [9]. As we have exposed, games have a potential for linking the problem solving to the curriculum. Therefore, it is interesting to notice that there is abundant evidence that computer games have a positive effect on student’s problem solving skills [62] [63]. Especially drill-and-practice games have been found successful in educational environments. [18] [3]. These are games where the students practice their prior knowledge rather than learning new knowledge. In addition to testing prior knowledge, it has been highlighted that games also can contribute to learning new material. It has been discussed that games have a potential for learning to develop creative problem-solving skills through observations, hypothesis testing and scientific simulations [10]. [8]. This implies that the students can use a variety of different skills and techniques in an integrated way, and as a consequence gain a holistic understanding of how complex systems work. Schell suggest that game like simulations have the possibility of serving as final exams in areas where multiple techniques need to be combined in a realistic setting, i.e. rescue work, geology, architecture, management etc. Moreover, one can assume that this benefits the students by thinking in a non-routine way and testing different strategies and problem solving methods.
8.2 Explorative learning

It has been claimed that user control and interactivity is essential for learning [25], and that interactivity between user, task and environment exists when the users senses are engaged in the action and they feel they are participating [14]. Lectures, books and videos have the property of being linear, and a linear medium is a very difficult way of introducing a complex system of relationships. As such, it seems that games have a unique potential of embodying non-linear system exploration. One can argue that the best way of understanding a complex system where multiple factors are involved is to play with it, and test the limits. As pointed out, the best way of understanding a complex system is to not only read about it, but also experience it [41]. Games give opportunities to test limits, and to understand the reasons for failing in a complex system. By experimenting and testing different strategies, the learner can develop a more holistic understanding, and be active in their own learning. [41]. Exploring while learning has also been shown to make the students test more advanced problem solving strategies compared to when they have less control over the outcome [31]. Furthermore, research has shown that the effect of learner control versus program control in instructional games, indicates that positive attitude and motivation is related to and favoring learner control [31].

8.3 Customization to different learning styles and cognitive levels

Games have the possibility to show things and information easier through visualization, and furthermore to enhance learning through visualization of concepts [50]. Games can improve learning through visualization and anchoring of abstract scientific concepts in a meaningful real-life context [65]. Additionally, it has been proposed that the possibility of using games in which the main purpose is learning, opens up possibilities to connect education to different learning styles [4]. Some students understand things best through visual input, while others learn best through listening or using logic reasoning. By designing the game to different learning styles, this could increase the motivation for and commitment to learning, since it allows the learner to choose between different representations of the material [5]. Another aspect worth mentioning is the possibilities of adjusting the game to different cognitive levels. Discussed by [36], when giving the player continuously feedback, the player can progress at his own speed according to his own abilities, and thus have the learning material adjusted to his individual progress.

8.4 Clear, specific goals leads to enhanced performance.

One of the most robust findings in the literature on motivation is that clear, specific, and difficult goals lead to enhanced performance [15] [28] [29]. Clear, specific goals allow the individual to perceive feedback to reach the goals, which are seen as crucial in triggering greater attention and motivation. That is, when feedback indicates that current performance does not meet established goals, the individual attempts to reduce this distance. Under conditions of high goal commitment, this discrepancy leads to an increase in effort and performance [16].

9. CRITICAL FACTORS IN GAME-BASED LEARNING

Even though Games have many opportunities in education, there are some critical factors stressed by researchers that are worth evaluating.

9.1 Teacher support

It has been stated that it is not enough to simply incorporate instructional games to contribute to learning [6]. The teacher’s ability to facilitate and embed the game within a learning methodology provides it with the context and meaning
required for learning to occur. [72] Successful use of computer games depends heavily on the framework and the environment around the learner, as shown in a study by Mayer et al. [66] They observed that a geology simulation was most effective when learner support was provided in addition to the simulation to help students visualize geologic features. Consequently, the quality of teaching, including the teacher’s skill in diagnosing pupils abilities and identifying learning objectives, are important for the game to be successful. [67] Therefore, the role of the teacher is to broaden the student’s perspective and to frame the actions and decisions from the game within a larger picture.

9.2 Support from traditional learning tools

It is noted that educational gaming yields best results when coupled with other educational activities [61]. We propose that an interactive learning game should not be seen as a complete learning tool; instead we should look at interactive games as a supplement to the teacher and traditional learning tools. The instructional effectiveness of a game depends on its characteristics, how it is used, and how it is used together with instructional activities to provide an effective learning environment.

9.3 Room for reflection

As shown earlier, user control is essential in learning for increased motivation and to learn complex systems [25], especially when the users have the opportunity to have an influence over the elements in their learning environment. However, it is stated that a direct manipulative interface can induce an implicit learning mode in the users. [68] In other words, an interactive learning tool can facilitate intuition based thinking when solving problems, solving problems by trial and error. Several researchers have made the same conclusion, arguing that high level of learner control could enhance the task engagement and user motivation, but not necessarily better achievements. [68] [69] [70] Thus, it seems that the learning effect of discovery-based learning are minimal, and that learners may complete task faster, but that they have problems demonstrating superior recall or retention of concepts. It has been argued that evidence for pure discovery-based learning in interactive learning is almost nonexistent, and that it is unrealistic to expect the learner to construct knowledge on their own based on explorative activities.

Since high level of control can lead to inefficient learning; it is stressed that effective learning must be supplemented with the opportunity to reflect and to extract relevant information [13]. This is important for learners to link knowledge gained to the real world. Many games have been used in education mainly for practice-drill games that leads to trying actions without reflection on the outcome. The players simply keep testing and experimenting until their scores improve. Such behavior in games is argued to not induce learning [38]. Further, there has been emphasized that there is a need for integration of educational theories from educators and teachers and game design to be able to design engaging educational games. A model for implementing problem-solving games in education is proposed by Kelly et al. [10]. In this model, reflection is vital for the learner in order to understand the process of the game and to set strategies.

9.4 Constructive Feedback

Regular feedback and evaluation of the player ensures that the player has control over his progress. It is important that the feedback not only informs if the answer was wrong, but also constructively lets the player know what can be done better [45]. That is, feedback should not only reveal that the players have done the task wrong/incomplete, but should also give hints so that they can change their knowledge to learn what they did wrong. This could be visual feedback, text or other forms.
9.5 Cognitive Mismatch

It has been pointed out that it is essential to give the learner a cognitive mismatch for learning to occur. [70] Tasks that are too easy or too difficult will only lead to boredom or frustration. [11] An example of a game where the challenge (jumping and dodging through the platform) increased in pace with the players ability, is the game Donkey Kong, an arcade game extremely popular in the 1970s. This game made the player progress in such a way that the challenges in the game gradually became more difficult. In that way, the pacing of challenges was structured so that the player experienced an enhanced competence through the game. The optimal amount of challenge/difficulty were matched the users skills and abilities [73].

9.6 The game goals should be integrated with the learning goals

When playing a learning game it is essential that the learning goals are integrated into the goals of the game, and not just add-ons that are isolated from the game play [21]. This means that the player needs to master the learning goals to reach the goals of the game [52]. Researchers stress that learning goals should be integrated into the endogenous fantasy of the game. So to reach the learning goals, it is necessary to practice skills and solve problems in the fantasy world. [11][13][14]. Two good examples of this is described by Malone (1981). The game Treasure Hunt makes the fantasy of locating and digging treasures dependent on the skill of plotting XY coordinates. The use of the skill is applied in a fantasy world-an actual treasure site map. The goal of the game (finding the treasure) depends on the skill of plotting X and Y coordinates [45]. Another example is the game Darts, where the fantasy of popping balloons is dependent on the students understanding of fractions. There also exist games where the use of skills is not related to the fantasy in the game. In these exogenous fantasy games, the learner progresses toward a game goal depending on the use of the skill. This could be that the learner has to answer correctly to math questions to progress further in the game. An example of this is the game Super cross, where the player learns math facts while riding a motorcycle [25]. Although the use of exogenous fantasy in learning games is a very easy way of doing it, it is less effective at promoting learning. [12]. The participants of such games are seen to perform more wild guesses and have less learning-oriented cognition.

10. DISCUSSION

As we have seen, games can contribute in many ways in an instructional environment, both motivational and to give a better understanding of learning theory. Still, there are several factors that are critical for implementing learning theory in games. Here we will discuss and summarize the literature reviewed above.

Several researchers has pointed out are elements from games that can nurture intrinsic and extrinsic motivation in the learner. Game mechanics, points, progress bars, etc. can make the learning content more appealing and fun, and foster higher self confidence. Higher confidence in turn, can lead to intrinsic motivation. The research on games and motivation reveals four important characteristics of games that nurture the player’s intrinsic motivation and engagement: Optimal challenge, curiosity, fantasy and user control.

The use of games in learning may be an excellent way of combining active learning with an engaging experience. The learning potential of games in education lies in the possibility of embedding learning in a meaningful context that links theory to practical use. Anyhow, it is shown that it is important to examine the interaction between learning and fun. Features from games could be added to instructional environments that would make them more engaging, but it would not necessary make them more instructional. Obtaining these intrinsically
motivational triggers from games while implementing learning theory seems to be the biggest challenge, as researchers has pointed out the importance of intertwining learning goals into the goals of the game. It is clear that this motivation effect rely heavily on how learning content is integrated into the game. Thus, if this is to be successful, there are some factors that are more critical than others and need to be taken into consideration:

1. The problem solving activity needs to be linked to learning theory
2. Give room for reflection, and not allow problem solving be done by trial and error
3. Merge the problem solving into the endogenous fantasy and context of the game
4. Feedback should be constructive, not only showing what is right or wrong
5. Focus on positive feedback, so that the learner gets a self confidence boost
6. The challenges of the game should ideally match different cognitive levels of the learner

Finally, in an attempt to give a broad overview over different game characteristics that can be used in an educational setting, we have summarized the theory reviewed in a table that shows how elements from games can contribute. We emphasize that the critical factors are essential when designing games that have the purpose of learning. This table is meant to serve as a guiding tool, and gives an indication of the factors that are worth considering when learning and games are combined. This overview only represents a starting point and does not attempt to present a complete overview over the relevant literature. Anyhow, it gives an overview that is easy to grasp and shows the findings in a structured way.
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<td>The challenges should ideally match different cognitive levels, so that cognitive mismatch is possible for different students. [70]</td>
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<td>Get to the next level</td>
<td>Optimal challenge are linked to flow witch are ideal for learning and can give intrinsic motivation [30] [43]</td>
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<td>Frequent short time goals and performance feedback leads to engagement [13]</td>
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</tr>
<tr>
<td>Goals</td>
<td>Beat the enemy</td>
<td>The student can decide their own learning direction [9]</td>
<td>Evidence for pure discovery-based learning is almost non-existent. Make room for reflection. [68] [13] [38] [53]</td>
</tr>
<tr>
<td></td>
<td>High score</td>
<td>High level of user control leads to increased intrinsic motivation [11] [43] [55] [53]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Learning goals</td>
<td>Get a holistic understanding of a complex system [41]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finding a treasure</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Save the world</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>User control</td>
<td>Explore game world</td>
<td>The student can decide their own learning direction [9]</td>
<td>Evidence for pure discovery-based learning is almost non-existent. Make room for reflection. [68] [13] [38] [53]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>High level of user control leads to increased intrinsic motivation [11] [43] [55] [53]</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Get a holistic understanding of a complex system [41]</td>
<td></td>
</tr>
<tr>
<td>Curiosity</td>
<td>Hidden information</td>
<td>Curiosity gives a intrinsic motivation to learn by letting the outcome of the game be uncertain [45]</td>
<td>To provoke the players curiosity enough to make the replay value high</td>
</tr>
<tr>
<td></td>
<td>Surprises (random feedback)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Incomplete information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sensory: sound, visual, vibration etc.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The use of game elements for increased motivation in game based learning
11. CONCLUSION

So, to summarize the findings in the literature, we will here point out the essentials of the matrix.

Games are fun because it has certain game characteristics that lead to intrinsic and extrinsic motivation. Several researchers have pointed out elements from games that can nurture intrinsic motivation in a learning context (fantasy, user control, optimal challenge and curiosity) and extrinsic motivation (rewards, points, graphics, feedback) in the learner.

External Motivation factors like points; progress bars, etc. can make learning content more appealing and fun, and foster higher self-confidence. Higher confidence in turn, can lead to intrinsic motivation. Anyhow, it is important that the feedback is constructive, so that the student can learn from his actions. Another important aspect is that the focus should lie on positive feedback, to build up self-confidence.

Problem solving related to a fantasy task can motivate the learner to try more and to link learning theory to practical context. It is important though, to make the challenges match different cognitive levels so that learning can fit the different skills of the students. It has been emphasized that if the learning theory should be linked to the endogenous fantasy of the game.

Further, games have the possibility to enhance problem-solving skills in education, and to link theory to a practical context by using the endogenous fantasy of the game. It is important that the problem solving task in the game is linked to learning theory and that the goals of the game are linked to the learning goals.

Problem solving should be implemented in the game by giving room for reflection and not actions based on trial and error.

Even though the guidelines are based on research embedded in empirical science and statements by well-known authors, we emphasize that learning and motivation is a complex condition that varies from learner to learner. Each learner has a unique way of learning that works best for him. There also exist many individual preferences regarding player motivation and player styles. We note that since self-esteem is a very critical factor for intrinsic motivation, an interesting thought is that maybe a learning game can give positive feedback if the learner has tried hard, even though he hasn’t solved the problem.

Some of the challenges are to provoke the student curiosity enough to make the replay value high, and to make them play the learning game over other commercial games. Games that have high replay value are characterized as those where the player has great possibilities to personalize the history and freedom to influence the outcome.

The literature shows that a high degree of user control makes the participants play a learning game without reflection. At the same time, it is noticed that a high degree of user control gives intrinsic motivation. In other words user control leads to a fun and motivating experience, but not a high learning outcome. This is, we think, one of the biggest challenges and a tension field in game based learning.

This said, we think that games have opportunities to be in line with a shift in science education from “learning by listening” towards learning in context
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