Tampere University

Jaakko Rajala

EDUCATIONAL MOTIVATION THROUGH GAME-BASED LEARNING

A case study on serious games in xMOOC

Bachelor's degree
Faculty of Information Technology and Communications
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ABSTRACT

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The purpose of this case study is to examine how educational games implemented in an xMOOC affect educational motivation and engagement. During the course, we implement several two-dimensional educational games for the web browser with an aim to help university students refine and learn crucial programming skills in selected web programming topics, then study the student responses to these games. The secondary objective of the study is to collect qualitative feedback from the students that can be used in the further development of game based learning. A total of 200 participants enrolled in the xMOOC and around 150 finished it.

The results indicate that students enjoy educational games and find them advantageous for their studies when these games are well implemented and fun to play. As a result, most of the games were seen as useful tools for visualizing abstract topics and reviewing educational content. When erroneous design decisions and instructions do not hinder student experience, educational computer games can make the lessons significantly more enjoyable and result in increased educational motivation. In this context, we can argue that using educational games in computer science contributes favorably to the learning setting if their design decisions and instructions do not lose focus on student needs.

Keywords: MOOC, xMOOC, gamification, game-based learning

TIIVISTELMÄ

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Tämän tapaustutkimuksen tarkoituksena on tutkia, kuinka xMOOC:iin toteutetut opetuspelit vaikuttavat koulutusmotivaatioon ja sitoutumiseen. Kurssin aikana toteutamme verkkoselaimelle useita kaksiulotteisia opetuspelejä, joiden tarkoituksena on auttaa yliopisto-opiskelijoita hiomaan ja oppimaan tärkeitä ohjelmointitaitoja valituissa web-ohjelmointiaiheissa sekä tutkimaan opiskelijoiden vastauksia näihin peleihin. Tutkimuksen toissijaisena tavoitteena on kerätä opiskelijoilta laadullista palautetta, jota voidaan käyttää pelipohjaisen oppimisen jatkokehityksessä. Yhteensä 200 osallistujaa ilmoittautui xMOOC:iin ja heistä noin 150 suoritti kurssin onnistuneesti.

Tulokset osoittavat, että opiskelijat pitävät opetuspeleistä ja pitävät niitä opiskelunsa kannalta hyödyllisinä, kun pelit ovat hyvin toteutettuja ja hauskoja pelata. Tämän seurauksena useimmat pelit nähtiin hyödyllisinä työkaluina abstraktien aiheiden visualisoinnissa ja opetussisällön tarkastelussa. Kun virheelliset suunnittelupäätökset ja ohjeet eivät haittaa oppilaiden kokemusta, opettavaiset tietokonepelit voivat tehdä tunneista huomattavasti hauskempaa ja kasvattaa koulutusmotivaatiota. Tässä yhteydessä voidaan väittää, että opetuspelien käyttö tietojenkäsittelytieteessä vaikuttaa suotuisasti oppimisympäristöön, jos niiden suunnittelupäätökset ja ohjeet eivät menetä huomion keskittymistä opiskelijoiden tarpeisiin.

Avainsanat: MOOC, xMOOC, pelillistäminen, pelipohjainen oppiminen

CONTENTS

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1. INTRODUCTION

Through the advent of online courses, colleges and universities have begun to provide education for students in ways that were previously unthinkable. A substantial percentage of students would not be restricted from enrolling at their institution due to a conflict between the time and location of classes at their institution. Students could now choose when and where to receive their education; however, they were still hindered by prerequisites, admission requirements, and affiliations with specific institutions.

In the first decade of the 21st century, Massive Open Online Courses (MOOCs) removed many, if not all, of these restrictions. With today's free post-secondary courses, virtually anyone can enroll, regardless of age, financial status, institutional affiliation, experience, or geographic location. A MOOC is designed to offer open-access education to a wide range of participants via the Internet. Depending on the implementation, the content of a MOOC may include filmed lectures, readings, and problem sets, as well as user forums or social media forums to foster community interactions among students, professors, and teaching assistants. Due to their widespread popularity in the field of distance education, MOOCs have become an extensively researched subject (Zhu, Sari & Lee, 2020).

MOOCs, while demonstrating great potential as an educational platform, do not come without faults. One of the most notable limitations of MOOCs today continues to be their low completion rates, which raises questions about whether they are truly capable of facilitating access to higher education (De Corte, Engwall & Teichler, 2016). While one plausible explanation for this is that learning through poorly designed MOOCs is not motivating for students (Lackner, Ebner, Khalil, 2015), it is also evident that learners have different motivations for learning and that, without appropriate incentives, not all students are enthusiastic about completing the entire course (Luik & Lepp, 2021).

Meanwhile, previous studies on game-based learning (GBL) suggest that serious games are an effective approach to enhance student motivation depending on the context and users. Quizz based games with educational storylines such as those offered through the Kahoot platform have shown signs of increased motivation among computer engineering students (Fuster-Guilló et all, 2019). Another comparative study on GBL conducted among first-year engineering students showed significant improvements in both motivation and performance when combined with traditional education (Pando, Fernández, Busto & Inglesias, 2022). Similar studies have also been conducted with MOOCs, where game-based learning increased learning motivation and educational outcomes of students (Hung, Sun & Liu, 2018). To better understand what makes a serious game successful, the current paper considers the subject through a more specific case study in a university setting. The results of this study shed light on the successful traits of educational game design and implementation, where the importance of visualization, helpful tips and instructions, and relevance of the learned subject is emphasized.

The paper is divided into multiple sections. First, the current understanding of the key concepts of MOOC and game-based learning is presented. Second, the research question and methodology are described. Third, the results section presents and parses the data, highlighting the interaction between the student as the learner and the integrated educational games of the course as the educational content to be reviewed. The concluding fourth and fifth sections focus to discuss the limitations of the study, the potential solutions to the problems discovered, and the observed benefits of GBL.

2. KEY CONCEPTS

2.1 xMOOC

In this study, our focus will be on an xMOOC. The x stands for extended course, or classroom extended online. The characteristics associated with an xMOOC are scalability of provision, acquiring a curriculum of knowledge & skills, and individual learning in a single platform. In contrast to other implementations of MOOCs, xMOOCs are structured like more traditional classrooms: pre-recorded video lectures with quizzes, tests, and other assessments, with the professor as the focal point of education.

Despite the many benefits MOOCs have brought through open access to education, MOOCs are not without flaws. Historically, MOOCs have suffered from low activity, fraud, deception, lurking, low completion and high dropout rates (Cooper & Sahami, 2013). In many cases, users complain that MOOCs are monotonous or boring. Further, MOOCs lack face-to-face interaction between students and teachers, as well as interactive videos. Collaborations and interactions are often encouraged in the platforms, but learners cannot effectively collaborate and interact (Toven-Lindsey, Rhoads, & Lozano -Lindsey, 2015).

2.2 Game-based learning, gamification

A literary review conducted by Rincón-Flores, Montoya, and Mena (2019) revealed that there are clear trends to improve the didactic design of MOOCs, highlighting innovative strategies such as gamification. According to their study, “gamification in xMOOCs promotes participants’ engagement regardless of age, gender, or educational level”. Challenge-based gamification is also found as a useful strategy for xMOOC students’ evaluation. Many important factors, such as social interactions in the form of large and small online groups are also highlighted for successful learning (Rincón-Flores et al., 2019).

In several studies (Lei, Chiu, Wang, Wang, & Xie, 2022; Hamari, Koivisto, & Sarsa, 2014), game-based learning and gamification have been shown to increase student motivation and enhance learning. Lei et al (2022) examined 41 studies with 6256 participants and found that game-based learning positively affected students' academic achievement more than traditional practices. In light of the wide variety of gamification approaches, Hamari et al. reviewed empirical studies from 2010 to 2013 and identified

several motivational factors relevant to game elements, concluding that gamification has a significant potential to boost learning motivation.

Game-based learning and gamification should nevertheless be used with caution. Studies show that extrinsic motivators may be helpful to motivate some students, but it has been shown that they can decrease intrinsic motivation in others (Hagedorn, Renz, Meinel, 2017). This was most notable when an intrinsically fun task ceases to be enjoyable as an extrinsic reward such as rankings starts to demotivate those who do not reach top rankings.

3. RESEARCH METHOD AND MATERIALS

The primary objective of this study is to evaluate the perceived effectiveness of several distinctive serious games as sources of learning motivation and education. The idea was to implement two-dimensional educational games for the web browser which aim to help university students refine and learn crucial programming skills in selected topics, then study the student responses to these games. The secondary objective of the study is to collect qualitative feedback from the students that can be used in the further development of GBL.

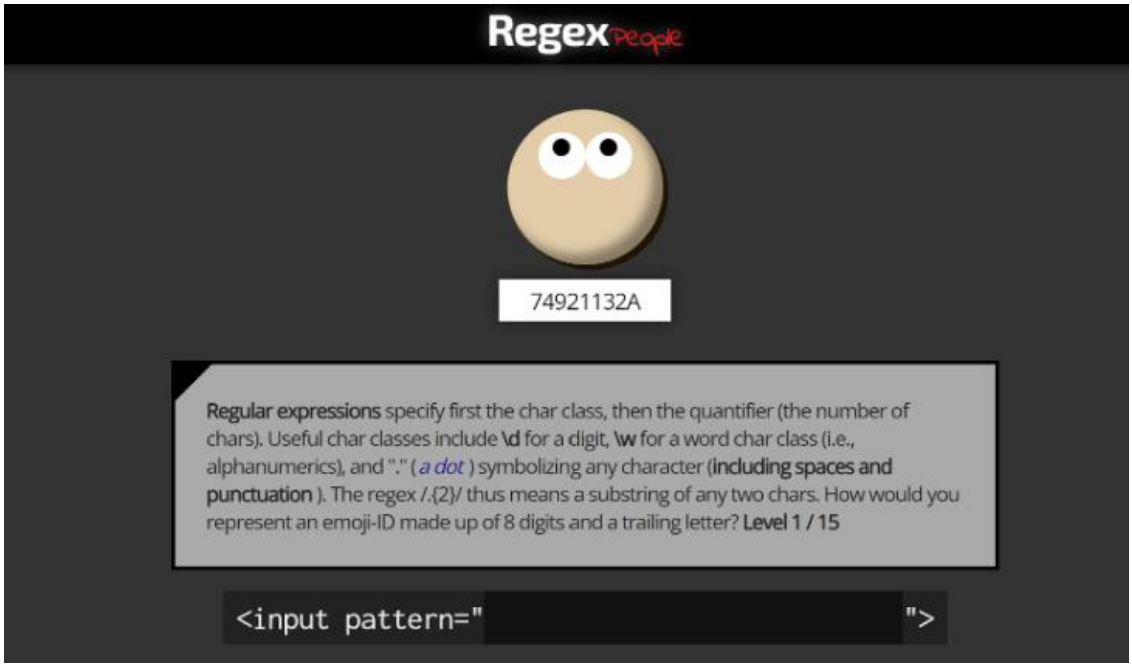
The object of this case study is an xMOOC that focused on the crucial basics of modern web development. The gamified course, Web for Content Authors and Information Scientists, was organized at Tampere University in the Spring of 2022.

The course lasted 8 weeks in total, consisting of three separate sections, each focusing on the three crucial aspects of basic web programming: HTML, CSS, and JavaScript. The course was set with the following objectives: After the course completion a student can implement quality www-pages, is aware of the requirements of accessibility, maintainability, and scalability, knows the current standards and recommended practices of HTML and CSS, and can implement dynamic web pages with the modern web technologies. The course started with 200 students enrolled from varying academic backgrounds and fields.

The course had several features which qualified it as an xMOOC for the context of this study. Firstly, the professor was the focal point of education. Each week lessons were first taught by the teacher, before the students were given the opportunity to repeat what they'd learned through weekly exercises. Secondly, most of the educational content was handled through a single platform, Plussa, with recorded video lectures, multiple-choice questionnaires, quizzes, traditional assignments, and serious games. Thirdly, an additional Teams channel was used for discussion forum participation. Albeit not obligatory, there was clear intent to encourage students to participate in open forum discussions, voice their concerns publicly, and share their knowledge with each other.

The following 4 educational games were included in the course materials: Regex People, CSS diner, Flexbox Froggy, and Grid Garden. What follows is a brief introduction to the contents of each game.

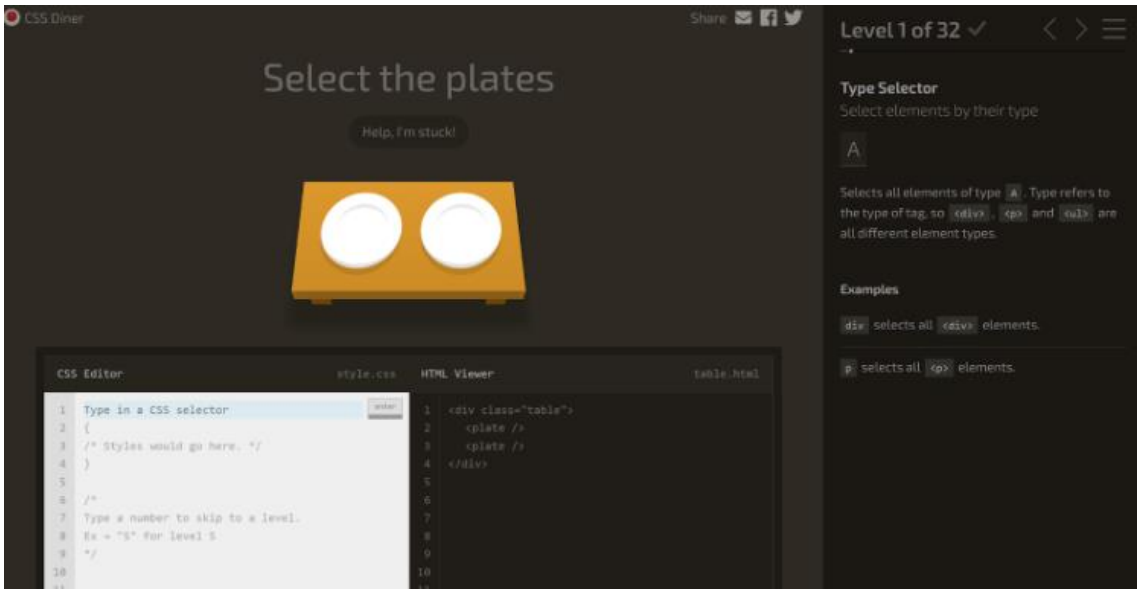
3.1 Regex People



Picture 1 – Regex People

Regex people (Picture 1) is a simple game for learning regular expressions as HTML pattern validation. Created originally by José Martín in Spanish, it was translated to English by the course staff and used as an assignment during the second week of the course. The object of the game is to select the correct person (emoji) using a regular expression that is inserted into the input-elements pattern attribute as a value. The game had 15 different levels, giving the positive feedback of a green hue circling the selected people each time a correct regular expression was successfully used. The completion of each level is reflected in the points received from the exercise.

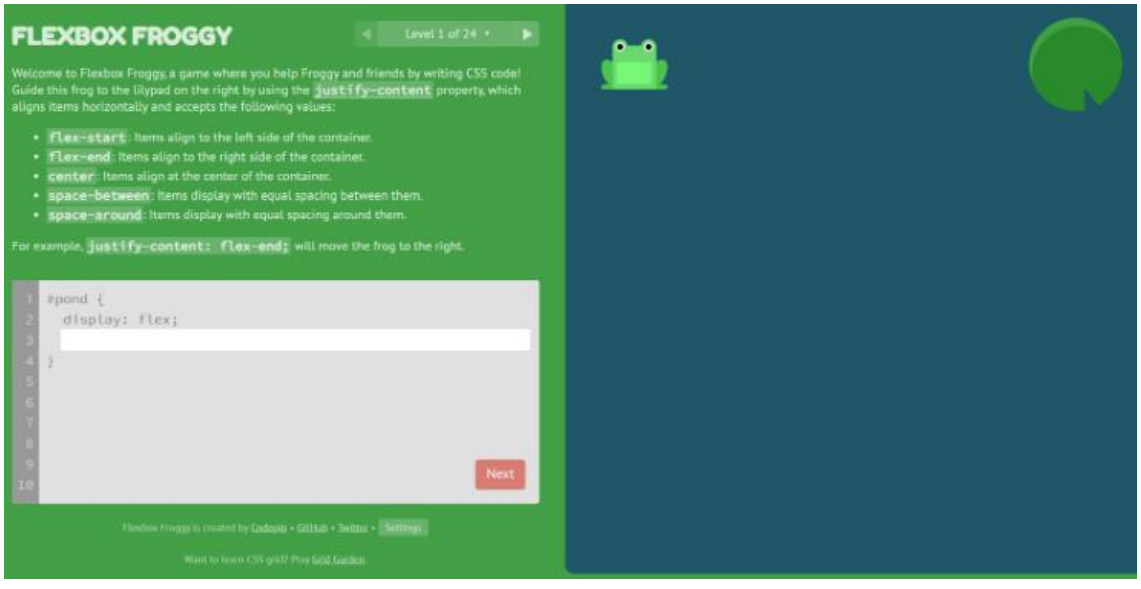
3.2 CSS Diner



Picture 2 – CSS diner

On the third week, the course moved on to the basics of CSS. There, CSS diner (Picture 2) was used as an exercise. Created by Luke Pacholski in 2016, CSS diner is an educational game about CSS selectors. It hosts 32 levels, in each of which the student was to use the provided CSS editor to select the instructed element that is displayed in the middle of the screen. The HTML structure is displayed next to the editor for ease of access. Each level hosts its own set of instructions and examples and is tied to the number of points the student received from the exercise.

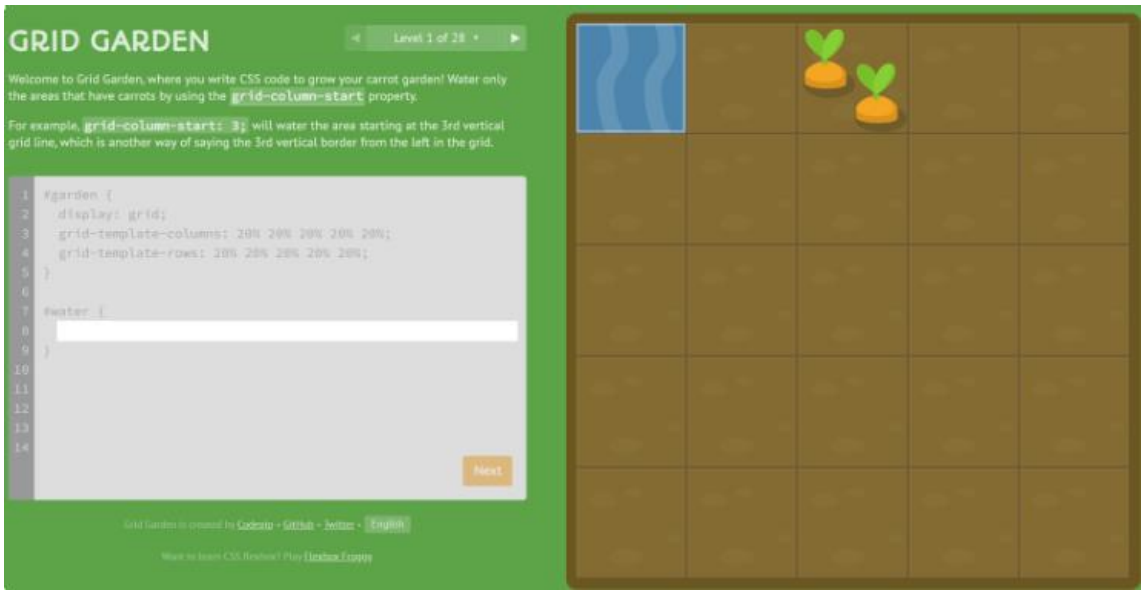
3.3 Flexbox Froggy



Picture 3 – Flexbox Froggy

Flexbox Froggy(Picture 3) was created by the team at Codepip. In Flexbox Froggy, the student helps the Froggy and friends reach their given lily pad using flexbox. Much like in the CSS diner, each level comes with its own set of instructions and examples. Each time the student successfully filled out the CSS with the flexbox logic, the froggy responded by moving to the specified location on the board. The game consisted of 24 different levels in total and was used as an exercise during week 4.

3.4 Grid Garden



Picture 4 – Grid Garden

Alongside Flexbox Froggy on week 4 we also had the Grid Garden (Picture 4). Also created by the team at Codepip, Grid Garden is an educational game where you learn Grid logic by tending to your virtual garden. In the story, the student protects their garden by watering the correct fields and poisoning the weeds. It hosted 28 levels in total and used a CSS editor that allowed the student to affect their virtual gardens' well-being in real-time.

Following IRB approval from The Tampere University Faculty of Information Technology and Communication Sciences (ITC), the data was collected by conducting a semi-structured mid-term survey as an internal course report. After the deadline for all the educational games had closed, week 6 students were provided the survey link as part of the week's learning module. The survey was conducted using the Google Forms platform and responding to it was voluntary, though students were offered 10 exercise points as a participatory incentive, reflecting 20% of the points required to pass that week's exercises.

4. THE RESULTS

Of the 200 students enrolled in the Web programming course, 164 had successfully made it to week 6. Of these students, 158 answered the game-based learning questionnaire (96,9% response rate). Overall, the response indicates positive effects in all relevant sectors.

4.1 Encouraging divergent thinking

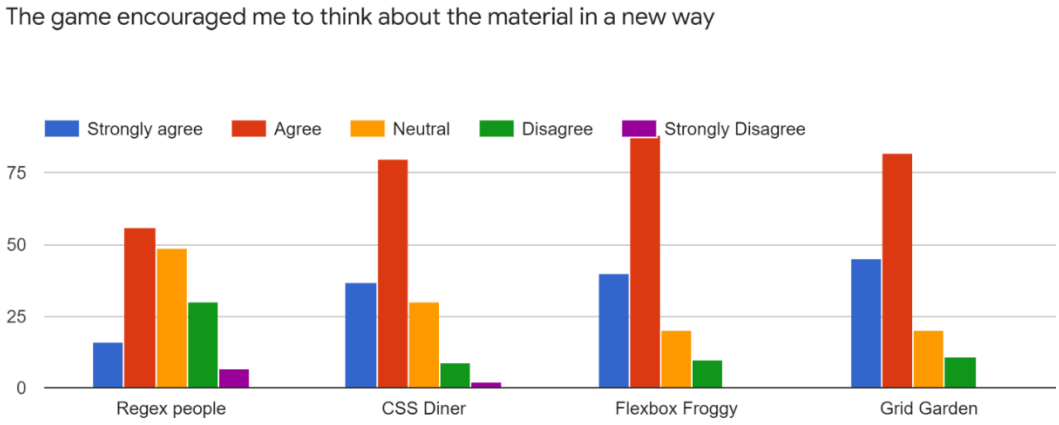


Table 1 "The game encouraged me to think about the material in a new way"; n=158; "1=strongly disagree" to "5=strongly agree"

The main intent of this question is to probe students on how the games encourage thinking from different perspectives.

A one-sample t-test indicates a statistical difference where most of the students feel that the games encouraged them to view the material in a new way (Table 1). Given the hypothetical mean of 3, which would have indicated that the games had no effect, students in fact felt encouraged by Regex People with a p-value of 0.004, CSS Diner p=0.000, Flexbox Froggy p=0.000, and Grid Garden p=0.000. Grid Garden received the highest score with an average of 4,03 (out of 5), Regex People receiving the lowest score of 3,25. The results indicate that students felt encouraged to divergent thinking through playing.

4.2 Recommending the game

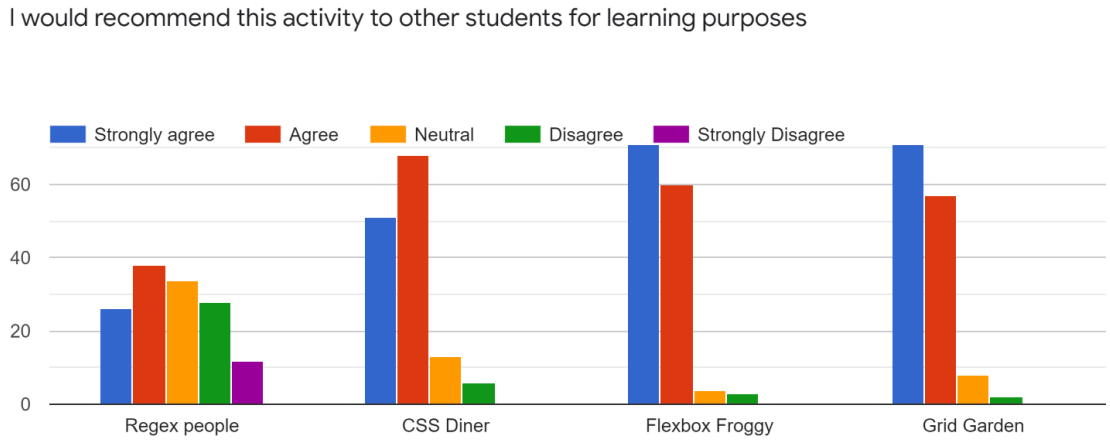


Table 2 "I would recommend this activity to other students for learning purposes"; n=158; "1=strongly disagree" to "5=strongly agree"

The one-sample t-test indicated a statistical difference where most of the students were likely to recommend the games to someone else (Table 2). Given the hypothetical mean of 3, students were likely to recommend Regex People with the p-value of 0.005, CSS Diner p=0.000, Flexbox Froggy p=0.000, and Grid Garden p=0.000. Flexbox Froggy was the most likely to be recommended with the highest score of 4,44 (out of 5), with Regex People receiving the lowest score of 3,30. This result shows the confidence of students in the usefulness of these games.

4.3 Reviewing the subject

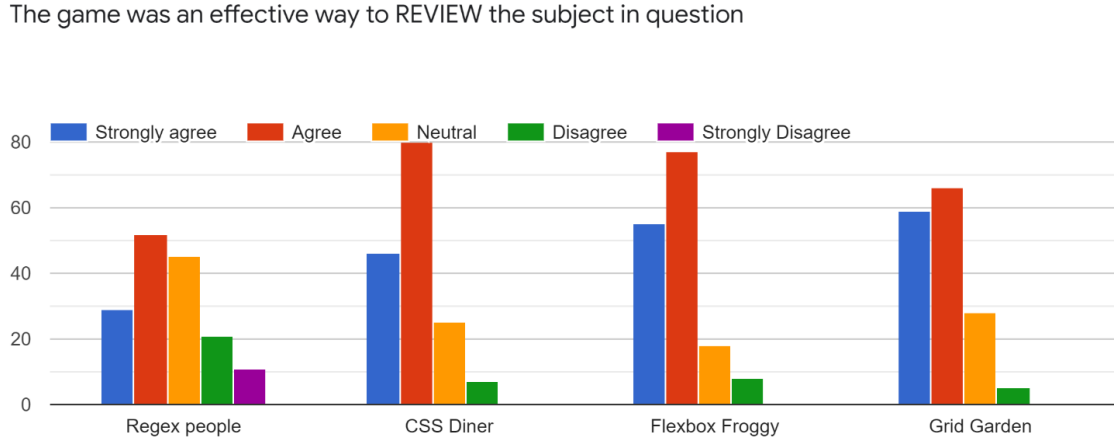


Table 3 "The game was an effective way to REVIEW the subject in question"; n=158; "1=strongly disagree" to "5=strongly agree"

A right-tailed one-sample t-test indicated a statistical difference when enquiring about the game's effectiveness to review the subject in question (Table 3). Given the hypothetical mean of 3, students felt Regex People with the p-value of 0.000, CSS Diner p=0.000,

Flexbox Froggy p=0.000, and Grid Garden p=0.000 were all effective ways to review the subject in question. This is an indication that the games were all seen as effective ways to review the subjects in question. Grid Garden was perceived as the most effective of the games to review its subject with the highest score of 4,15 (out of 5), with Regex People receiving the lowest score of 3,43.

4.4 Effectiveness for learning new information

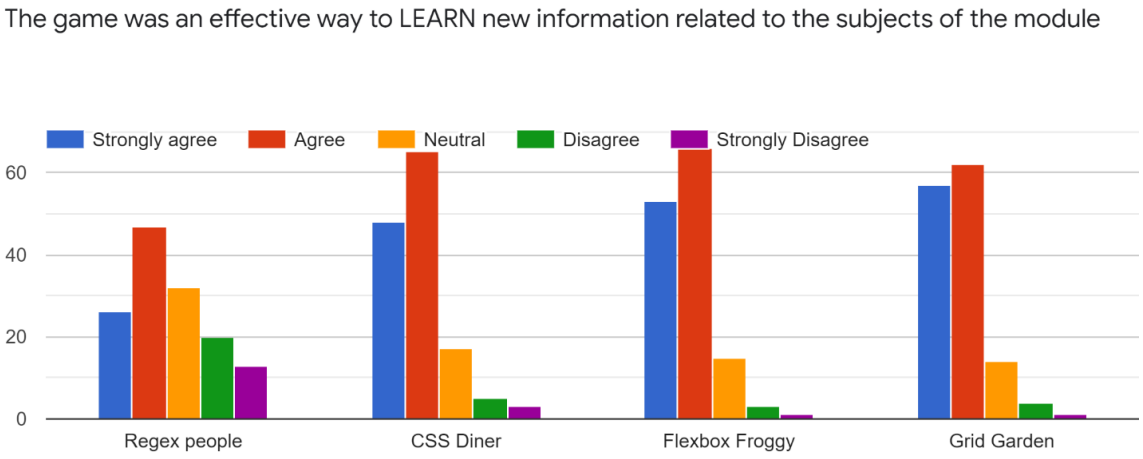


Table 4" The game was an effective way to LEARN new information related to the subjects of the module"; n=158; "1=strongly disagree" to "5=strongly agree"

A right-tailed one-sample t-test indicated a statistical difference, as most of the students felt that the games were an effective way of learning new information (Table 4). Given the hypothetical mean of 3, students felt Regex People p=0.005, CSS Diner p=0.000, Flexbox Froggy p=0.000, and Grid Garden p=0.000 were all effective ways to review the subject in question. Grid Garden was perceived as the most effective of the games to learn new information with the highest score of 4,23 (out of 5), with Regex People receiving the lowest score of 3,413. The result shows that the games were all seen as effective ways to learn new information related to the subjects in question.

4.5 As a motivating factor

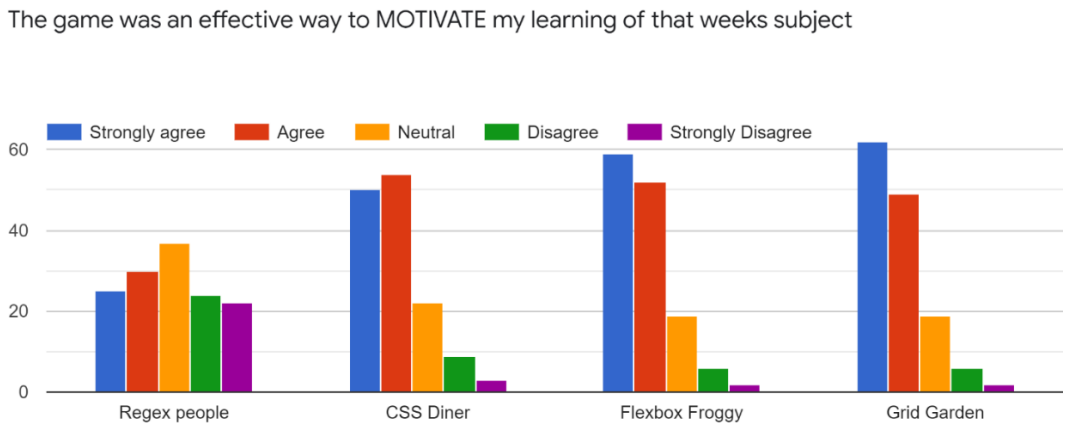


Table 5" The game was an effective way to MOTIVATE my learning of that week's subject"; n=158; "1=strongly disagree" to "5=strongly agree"

Upon the question of motivating learning, a right-tailed one-sample t-test indicated a statistical difference in most of the games (Table 5). Given the hypothetical mean of 3, students felt CSS Diner p=0.000, Flexbox Froggy p=0.000, and Grid Garden p=0.000 were all effective ways to motivate learning the subject in question. Regex People was an exception to this with a p-value of 0.192. Grid Garden was perceived as the most effective of the games to learn new information with the highest score of 4,18 (out of 5), with Regex People receiving the lowest score of 3,10. The results show that while games can also motivate learning, not all game designs are necessarily successful in their delivery.

4.6 Distractions from non-educational portions

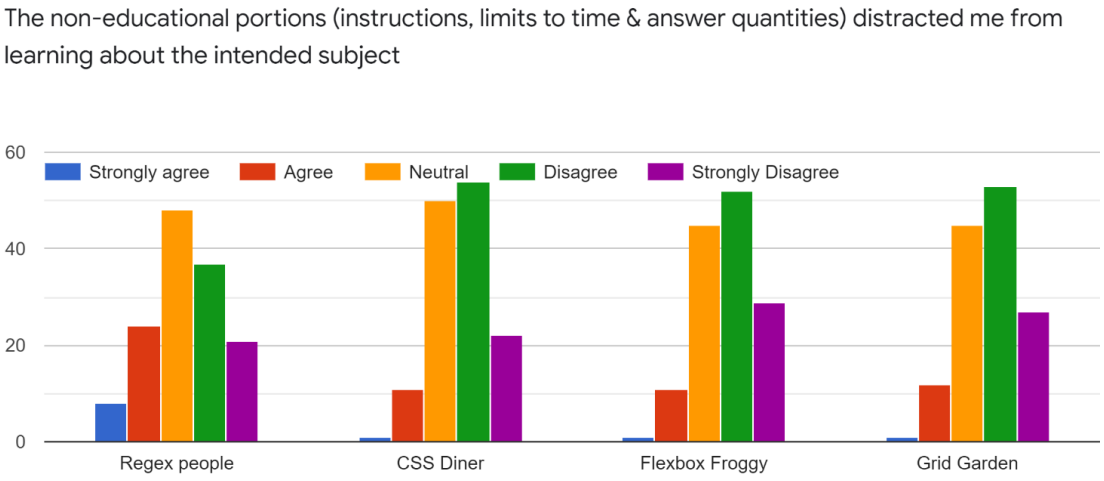


Table 6" The non-educational portions (instructions, limits to time & answer quantities) distracted me from learning about the intended subject"; n=143; "1=strongly disagree" to "5=strongly agree"

Based on a left-tailed one-sample t-test, we found that students were not distracted from learning by the non-educational features of these games (Table 6). Given the hypothetical mean of 3, students felt that the non-educational portions in Regex People p=0.001, CSS Diner p=0.000, Flexbox Froggy p=0.000, and Grid Garden p=0.000 did not distract them from learning about the intended subject. Flexbox Froggy was perceived as the least distracting of the games with the lowest score of 2,30 (out of 5). Regex People received the highest score of 2,71, consisting of the most distracting non-educational portions.

4.7 Distractions from bugs and game design

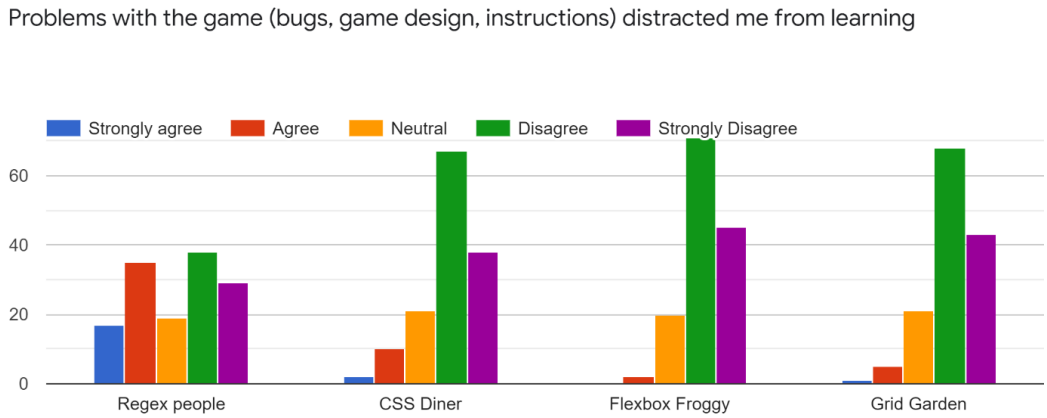


Table 7" Problems with the game (bugs, game design) distracted me from learning"; n=158; "1=strongly disagree" to "5=strongly agree"

The study also found that problems related to bugs or game design did not distract students from learning, though there were some exceptions (Table 7). Given the hypothetical mean of 3, students mostly felt that problems in CSS Diner p=0.000, Flexbox Froggy p=0.000, and Grid Garden p=0.000 did not distract them from learning about the intended subject. This either means that the students did not encounter any problems, or that the problems that were encountered did not hinder their educational goals. In Regex People there was no such indication with a p-value of 0.043, as a significant proportion of the students (23,4%) felt that the problems with the game distracted them from learning. Flexbox Froggy was perceived as the least distracting of the games in terms of problems with the lowest score of 1.88 (out of 5), with Regex People receiving the highest score of 2,81. The result suggests that educational games can be designed in a way that does not distract students from learning, but that issues with the game can in turn severely impact learning negatively.

4.8 Learning by playing games versus didactic lectures

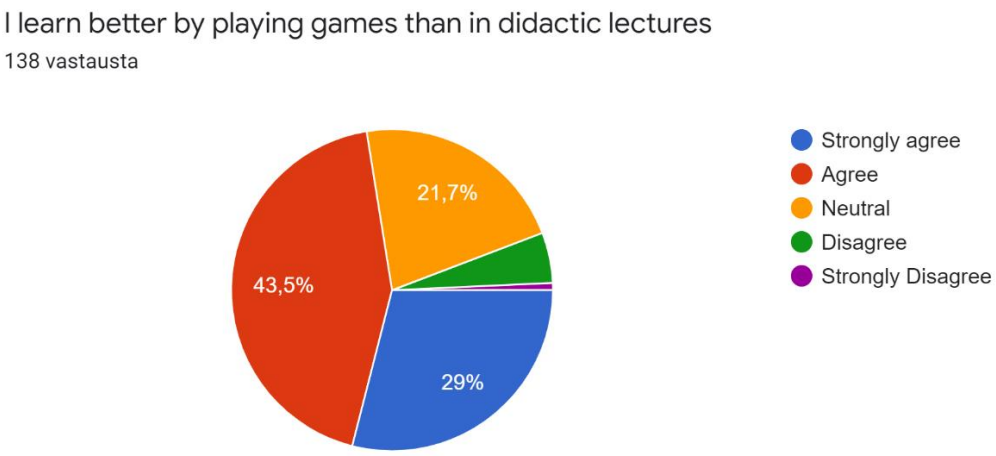


Table 8 "I learn better by playing games than in didactic lectures"; n=158; "1=strongly disagree" to "5=strongly agree"

The results suggest that the students felt they learned better by playing games than through didactic lectures (Table 8). The t-test indicated a statistical difference when, given the hypothetical mean of 3, the average mean from the gathered data amounted to 3.93 with a standard deviation of 0,88. Of the students, 72,5% either agreed or strongly agreed with the proposition. This suggests that at least among students of computer science, there's a very firm perception that favoring GBL over didactic, traditional education would improve learning outcomes.

4.9 Motivations for learning

135 responses to the question of "what motivates your learning in general" were available for analysis. This study attempted to include all personal statements on learning to capture all occurring themes. Data were analyzed in a deductive way for descriptions of motivation and other themes described by applicants simultaneously (it was expected that the statements on motivation could also contain themes beyond the scope of the questionnaire).

First, statements were separated between motivational and nonmotivational (additional). Secondly, based on an earlier understanding of motivation through a premade framework of SDT (Wouters et al, 2014), autonomous and controlled forms of motivation were differentiated within the motivation-related themes.

Of the responses, 64 statements were identified as autonomous motivation. Autonomous motivations stem from intrinsic interests, ambitions, or enjoyments. The following are examples of autonomous motivation in this context:

"Being able to learn small things one by one, that are relevant, to be ready to tackle larger problems. This is the way I stay motivated, especially in coding. The true motivation of learning is being able to access new knowledge to be able to use it in the future in some way or other. "

"Challenges and succeeding in challenges, developing as a person"

"*I like to play games, so gamifying coding is an excellent way to motivate! Overall, I like to do something instead of just reading or writing"*

"The flow and the feeling you get when you succeed. Getting stuck is annoying, which is why these games were fun. Smaller puzzles to solve quite quickly."

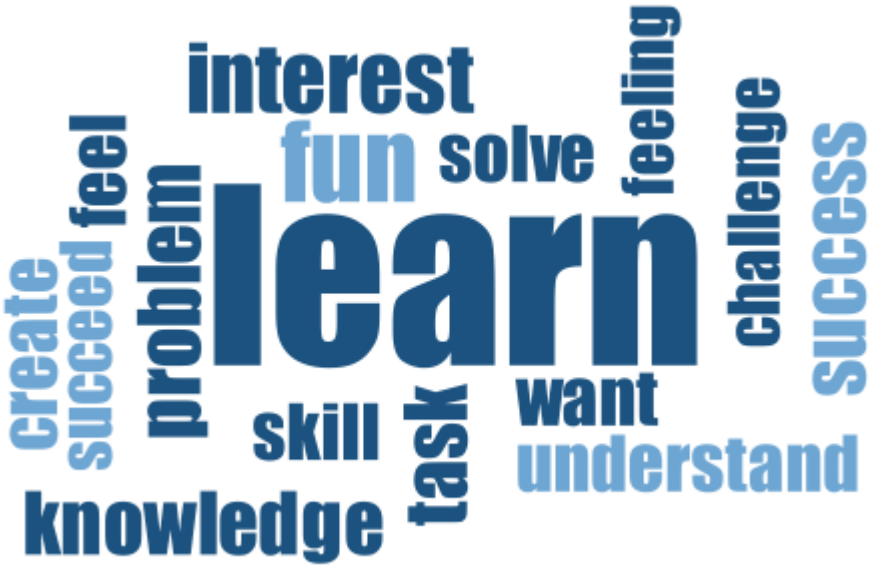


Figure 1. *Word cloud on autonomous motivations*

A generated word cloud was used to identify 16 frequent words that were used in sentences focusing on autonomous motivations. The three most frequent words that were used in these sentences were "learn" (6,69%) with a frequency of 23, "fun" (2,33%) with a frequency of 8, and "interest" (1,74%) with a frequency of 6. The autonomous motivations of students focused on learning new skills, having fun while learning, and personal ambitions and interests.

Meanwhile, 71 of the statements were identified as controlled motivations. Controlled motivation is driven by external motivators, such as promised rewards or punishments, whereby motivation persists only if the motivator exists. Examples of responses that were categorized as controlled motivations are:

"*My motivation is to get the course points*"

"Seeing instant results which the games support well"

"Seeing the progress, for example, the concrete results of my code in the game (frog moves to a different spot, etc.). It also helps to have the task divided into manageable pieces so that I must solve one problem at a time. "

"Clear instructions and interesting topic"

"Getting to know what the subject will be useful for in the future. And the possibilities that it may open."

***Figure 2**. Word cloud on controlled motivations*

Generating student feedback in the form of a word cloud revealed 19 distinct words from the statements categorized as controlled motivations (Figure 2). The most frequented words were "progress" (2,80%) with a frequency of 11, "instruction "(2,29%) with a frequency of 9, and "subject" (1,78%) with a frequency of 7. The controlled motivations of students focused mostly on the ability to see their progress, being given clear instructions

for assignments, jobs, and tasks, and focusing education on subjects that would be useful for their future.

4.10 Student feedback on the games

The final part of the GBL questionnaire allowed students to voice their feedback and development ideas freely regarding the games. We received 85 responses in total, the majority of which focused on the problems with Regex people. The most used words were games (10.2%), regex people (9.18%), and instructions (9.18%) (Figure 3).

Figure 3. *Word cloud of relevant words in student feedback*

Statement analysis revealed 153 segments that were separated between two main themes: feedback and suggestions. Feedback was further classified as negative, and positive feedback. Of these 153 segments, 78 were game-specific feedback and suggestions, so feedback and suggestions were further divided among the games based on which game was mentioned or referred to in the feedback. 75 sentences were identified as general feedback and suggestions. 29 of these were identified as suggestions for improvement, 17 as negative feedback, and 29 as positive feedback. The next subsections will analyze each of the given themes separately.

4.10.1 Negative Feedback

While other games and general feedback also received some statements, most of the negative feedback focused on Regex people. In total, 70 of the statements were identified as negative feedback, 29 of which were general and the rest game specific. 36 of the game-specific negative feedback focused on Regex People, with Grid Garden and CSS diner receiving 1 and 4 respectively. Flexbox Frog did not receive any negative

feedback. This further indicates that for a fair portion of students the game “Regex People” did not meet expectations as well as its counterparts.

Negative feedback focused mostly on game design and guidelines. Educational instructions and materials left some students confused and resulted in extensive searching and extended completion time. Other problems with game design focused on styling as well as game functions, such as the inability to check or save your previous answer. Sometimes negative feedback was incongruous, as some described repetition in tasks as exhausting while to others repetition was a necessary part of the learning curve and considered a helpful addition.

Examples of general negative feedback:

“You can’t really play the games a little bit at a time because you can’t save your answers”

“The games can be a little frustrating if you don’t quite get the idea”

“I can’t even see the text in the games sometimes”

“A lot of small (and somewhat repetitive) tasks were exhausting at times.”

Examples of game-specific negative feedback:

“Instructions were difficult to understand.” (CSS Diner)

“*didn't play it because I didn't understand how the selectors were supposed to be presented.” (CSS Diner)*

The game-specific negative feedback on Regex People additionally concerned issues that were not present in other games. Some of the problems reported by students concerned difficulties playing the game due to apparent bugs, while others found the task itself too confusing or difficult. The necessity and usefulness of the game and its topic were also questioned.

Examples of negative feedback on Regex People

“Annoying to do and don’t feel like it was a necessary subject for the module”

“It took me too much time to figure out how the game works”

“Compared to others, the instructions on Regex People were inferior”

4.10.2 Positive Feedback

Positive feedback focused on the ability of the games to contribute to student learning and enjoyment. 37 segments were identified as positive feedback, most of which was general. Some students considered the games as good introductions to the topics, others said they were a good or a fun way for them to learn. A few students made a positive mention of the ability of these games to help visualize the subject in question. There were also statements of appreciation for including the games as part of the course.

Examples of general positive feedback

“I really enjoyed seeing how changes in my code affected the game so I could figure out what to do differently.”

“Overall games were very good and motivating tasks.”

“These were a fun change to usual exercises.”

“The amount of information to take in per game level was good.”

“Games helped to visualize the subject!”

4.10.3 Suggestions for improvement

Suggestions for improvement focused on possible solutions to the previously listed negative feedback, focusing mainly on the instructions. Of the 51 suggestions for improvement, 29 were general, and 18 focused on regex people. The most frequent word used was “instructions” with a frequency of 19. These suggestions focused on clearer instructions, hints, and tips to illustrate how the game works and enforce the educational goal.

Examples of suggestions for improvement

“Instructions especially with Regex people could have been more informative”

“Make the instructions so clear that the effort can go into learning the subject matter not figuring out what the rules of the game are”

“Hints for when you get stuck”

“There could be a part of doing and evaluating the actions, e.g. ‘What happens when you type this?’”

5. DISCUSSION

Due to the limitations of this study, pre- and post-knowledge was not assessed, and neither was feedback gained from students that had previously dropped out from the course. While gaining their insight would have been an asset in understanding and addressing unseen problems, a high dropout rate in the course would have also hindered the reliability of this study. With 164 of the 200 students remaining in the course, we had a dropout rate of 18% before the survey. Given the rule of thumb that up to a 20% dropout rate can be considered acceptable (Furlan et all, 2009), the study did not exceed the limit in this context. Of these 164 students, over 96,9% answered the survey, indicating that the students were very willing to participate when given the opportunity to do so.

As most of the feedback is constructive criticism on game guidelines and design, further development is needed in these sectors. Erroneous styling decision in “CSS diner” where the font color blended with the background of its instructions should be addressed with better contrast. Games such as “Regex people” should additionally focus on context by adding more informative instructions and tips to clarify gameplay and its educational benefits. Some “Regex People” specific design choices such as the inability to skip problematic levels were also raised as issues, mostly since its counterparts offered a simple toolbar to do so. A similar toolbar should be included in “Regex people” and any future educational games if the specific level is not deemed mandatory. Further development of these educational games must also consider different models in student experiences, learning abilities, and time management. The results suggest that offering both easier but repetitive as well as challenging but less repetitive levels would improve player experience. Potentially, lessening the effects of repetition exhaustion could also be achieved with games that offer education on multiple different educational subjects simultaneously. This could be a potential subject of a separate study. Another iteration of this course is planned for next year, presenting an opportunity to implement fixes, improvements, and updates accordingly.

Nonetheless, based on our opinion poll, the attempt to engage and motivate students through game-based learning in this course is a success. Adopting an innovative, game-centric design in a beginner-friendly web development course met overwhelming praise and gratitude. As negative feedback and criticism focus on problems with game design and guidelines, positive feedback on these games emphasizes primarily experiences of creativeness, delectation, and enhanced learning, and requests for more serious games were frequent. This sentiment was further emphasized by the high grades the games

received in the GBL survey, with students grading the games high in terms of motivational and educational value. The aim of educational games in computer science is to ensure students apply their critical thinking, reinforcing learning and real-world adoption of taught concepts. While the completion of these goals cannot be confirmed through our survey, there was still a very firm student consensus that favoring GBL over didactic, traditional education would improve learning outcomes. Further research could be directed to assessing pre- and post-knowledge of students attending other course variations with and without similar GBL elements.

6. CONCLUSION

The purpose of this study was to evaluate the perceived value of specific serious games as a source of student motivation and education in a university setting. The findings of this study show that students enjoy educational games and find them advantageous for their studies when these games are well implemented and fun to play. As a result, most of the games were seen as useful tools for visualizing abstract topics and reviewing educational content. When erroneous design decisions and instructions do not hinder student experience, educational computer games can make the lessons significantly more enjoyable and result in increased educational motivation. In this context, we can argue that using educational games in computer science contributes favorably to the learning setting if their design decisions and instructions do not lose focus on student needs.

This paper describes an exploratory case study of game-based learning in an xMOOC at a university setting. It included a relatively small sample size which might hinder the generalization of the results. The provision of specific natural examples will, however, help clarify our understanding of educational processes based on an understanding of naturalistic generalization (Stake, 1978). A study conducted with an extensive data collection and analysis procedure, as in this case study, is all the more valid. The sample included a good representation of the MOOCs' population, and the participants' statements and assertions were thoroughly examined despite the relatively large qualitative sample size. We can therefore apply our methodological framework to other GBL studies, adding to the growing body of knowledge regarding game-based learning in a MOOC setting.

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