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Can Tangible Gamification Be An Alternative to Digital Counterparts? A Case Study on Student Perspectives

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Abstract

This study aims to determine secondary school students (n=23) perspectives of tangible gamification elements. For this purpose, the mathematics teaching process of a group of fifth-grade students (10 years old) was assisted with tangible gamification elements. These elements were designed with a traditional pen-paper approach, appropriate to the age level of the students. The research was conducted with qualitative methods. The case study design was preferred as a qualitative research design. Following the 10-week implementation process, the students were requested to provide their opinions on tangible gamification elements. The main research data were collected using a semi-structured interview form using the focus group interview method. To triangulate the data obtained from the focus group interviews, data collected from researcher observation notes and student diaries were also used. The research data were analysed by content and text analysis methods. The study concluded that tangible gamification elements provide positive experiences to students. In addition, it was determined that a few revisions were needed regarding the gamification elements used in the research. This study serves as a guide for educators on the use of tangible gamification in learning environments. The current study provides a set of recommendations on tangible gamification for educational settings.

Keywords: Educational gamification, Gamification, Gamification elements, Gamified learning, Tangible gamification.

Introduction

Gamification, which aims to increase individuals' motivation and commitment to their environments, is increasing in popularity worldwide. Gamification is "equipping non-game processes with game design elements" (Author & Author, 2021). In addition to its use in areas such as marketing and health, gamification is a key approach that can be used in educational settings to increase students' motivation and engagement levels. In this regard, the growing interest in educational gamification in recent years is noticeable (Oliveira et al., 2022).

Deficiency of motivation in educational settings is one of the primary problems of the learning processes (Albrecht & Karabenick, 2018). Educational gamification can positively affect learning motivation with its features (Manzano Leon et al., 2021). Recent research indicated that gamification can positively influence students' communication abilities, engagement, attitudes, and motivation (Gonzalez Fernandez et al., 2022). The results of related examinations in the literature emphasize that educational gamification can contribute to a better learning experience for learners (Saleem et al., 2022).

In the literature, gamification has a variety of definitions. Deterding et al. (2011) define gamification as the application of game strategy concepts in non-game settings. According to Werbach and Hunter (2012), gamification applies game strategy principles to non-gaming contexts. Koivisto and Hamari (2014) describe gamification as the process of creating game-like experiences. In summary, gamification can be defined as the integration of game design factors such as avatars, badges, and points into non-game contexts. It can be said that gamification has entered into educational settings rapidly and effectively with the help of its game philosophy and ease of application. The term educational gamification is often associated with engagement, learning motivation and creating positive learning behaviour (Smiderle et al., 2020). Although there is no platform requirement or limitation, educational gamification has become mentioned together with e-learning with the effect of developing and widespread technological opportunities (Yığ & Sezgin, 2021).

Although it is mostly preferred with digital platforms, gamification can also be carried out with traditional pen-paper applications (Jagust et al., 2018). Tangible gamification can be identified as making game elements tangible through various non-digital materials and using them as a whole for a specific purpose. The embodiment of gamification elements with traditional methods facilitates the adaptation of gamification to educational environments. Thus, gamification elements can be more easily adapted to the characteristics of individuals and pave the way for personalisation of the process for each student (Author & Author, 2021). In addition, tangible gamification facilitates accessibility by presenting game elements to participants independent of time, place and digital devices. In line with this idea, it can be said that tangible gamification has the prospect of positively influencing learners' commitment to the learning environment.

Even though tangible gamification has the potential to influence the learning process positively, it is still a matter of debate whether it can be a proper alternative to its digital counterparts. Author (2019) conducted a study with secondary school students to explore the impact of tangible

gamification elements on their learning processes in mathematics courses. The research found a positive increase in students' academic achievement in mathematics, but no notable difference was found in their attitude levels. Additionally, students reported positive and enjoyable experiences with the tangible gamification elements.

Dodero et al. (2014) investigated whether embodied gamification elements affect primary school students' participation levels in learning activities. The study concluded that adapting tangible elements to the learning environment, such as the progress bar, map, and store, increased students' participation in classroom practices. In addition, the study uncovered that students were interested in the embodied gamification elements and were satisfied with their experience using these tangible elements. Gennari et al. (2017) aimed to specify the effect of embodied gamification applications in their study with primary school students. After conducting research, it was found that students are more cooperative and engaged in classroom activities.

Ortega Arranz, Bote Lorenzo et al. (2019) conducted a set of experiments to comparison of badge and reward elements in gamification. The results of the study, in which the badge element was applied digitally and the reward element was applied tangible, show that there is no remarkable difference between the two element types. Bai et al. (2021) aimed to analyse the effect of the embodied reward element in an online learning process that was designed based on the virtual point element. The results showed that students' participation in learning activities increased, but there was no significant change in their learning performance. Xiao and Hew (2023) experimentally compared the virtual and tangible forms of the reward element of gamification in their study with undergraduate students. As a result, there was a significant increase determined the motivation, learning performance, and engagement of the students in the tangible reward element group.

Upon examining studies on tangible gamification in the field of educational sciences, it becomes clear that many studies are conducted with limited comparisons based on only a few elements of gamification. Moreover, these studies have reported mixed results and no common conclusion has been reached. The studies conducted thus far have not applied tangible gamification as a concept, nor have they sufficiently examined student views on its use in the classroom environment. This is an indication that qualitative results on tangible gamification are insufficient in the literature and it reveals the need for research to be carried out with this approach.

This research was planned with the main idea that educational gamification can also be applied to non-digital designs in the classroom environment. In light of this main idea, the current study investigates the answer to the question "What are the perspectives of secondary school students toward the tangible gamification elements?". Accordingly, the current research aims to examine the perspectives and experiences of secondary school students regarding the tangible gamification elements that were designed as a concept according to the nature of the learning environment. For this purpose, the case study approach, which is one of the qualitative research designs, was preferred for the research. The focus group discussion method was preferred as the main data collection method. In addition, student diaries and researcher observation notes were employed to triangulate the data obtained from this main data

collection method. The data collected through these methods were analysed by content and text analysis methods.

The present study has a set of limitations. Initially, the participants of the study were limited to 23 students from the fifth-grade (age 10) level. Secondly, only the elements selected and customised from the Pyramidal Gamification Design Model (Werbach & Hunter, 2012) were embodied and used in the study. Additionally, the research was limited to the mathematics course, which consists of five sessions class per week. Lastly, the research is temporally limited to a total of 11 weeks, including one pilot test week. Despite the existing limitations, this research provides valuable practical information about using gamification in the classroom environment. It is considered to serve as a gamification guide that educators can implement to enhance their learning environments. Therefore, the current research is anticipated to provide an innovative contribution to the educational gamification literature.

Methodology

Research Design

The case study method was preferred as the research design of this study. The case study approach is one of the qualitative research designs. A qualitative case study investigates and analyses an event in a real-life context in detail within a limited system (Merriam, 2009). The approach aims to analyse personal and private experiences (Stake, 2005). The qualitative case study design is advantageous for conducting in-depth investigations into the reasons behind a specific phenomenon in a sociological context (Yin, 2018). In this study, the qualitative case study design was preferred for examining the perspectives of secondary school students on tangible gamification elements in detail.

Study Group and Ethical Considerations

The homogeneous purposive sampling method was used for determining the research for the study group. This method is one of the purposive sampling methods. Homogeneous sampling involves deliberately bringing together individuals who share a common characteristic or experience (Fraenkel et al., 2011). This study aims to specify students' perspectives of tangible gamification elements. Therefore, the research study group has a shared experience with the elements used in the study. Consequently, the homogeneous sampling method was preferred to establish the study group.

The research study group was performed with fifth-grade students in a public school located in the Western Black Sea region of Türkiye during the 2022-2023 academic year. The study group class was randomly selected from among the fifth-grade classes in the school. The class consisted of 23 students, 12 girls (52.17%) and 11 boys (47.83%), aged 10 years. In Türkiye, students between the ages of 10-14 are studying at the secondary school level. The youngest grade in the secondary school group is fifth grade, with an age level of 10 years. For this reason, fifth-grade students are thought to be more prone to games and game culture in terms of interest than other secondary school levels (Boyd & Bee, 2014). Since this study is about gamification, it was decided that the fifth-grade level was appropriate for the study group.

The research was carried out for a total of 11 weeks, including one pilot test week and 10 implementation weeks within the scope of the mathematics course. The pilot test week was conducted to increase students' familiarity with the process. The data related to the pilot test week were not contained in the research data. Each student in the study group (n=23) fully participated in the 10-week implementation process and no student left the implementation until the end of the process.

This study was conducted under the research permission protocol of the Institution University Ethics Committee (date and number: 06.03.2023-E.603958) and the Institution Governorship (date and number: 13.04.2023-E-10240236-20-74353790). The study was conducted following academic ethical principles (Lodico et al., 2010). Student attendance was voluntary, and they were notified of the research purpose and implementation process beforehand. Additionally, students were made aware that they could withdraw from the research applications at any time. As the study group comprised students under the age of 18, written permission was obtained from their parents for their participation in the research. The students and parents were advised that any data collected would be used solely for this research. Official correspondence was conducted with the relevant institutions before the research, and all necessary written permissions were obtained.

Researcher Role

The current research is based on qualitative data collected within the scope of the doctoral dissertation of the corresponding author. The second author of this paper contributed as a doctoral dissertation supervisor to the research. In addition, the corresponding author is the mathematics teacher of the study group in which the research was conducted and acted in the implementation process in this role. The corresponding author assumed the role of the study group course teacher due to the prolonged engagement reliability measure in qualitative research (Creswell, 2012). This decision was made to ensure that students would feel more comfortable expressing themselves to a familiar teacher. Moreover, the corresponding author prepared the interview form and collected observation and document data. Focus group discussion interviews and video recordings of these interviews were also conducted by the corresponding author. The second author, who has a doctoral degree in Educational Technology, supervised the research process. The analysis of the research data was performed by the authors of the study.

Gamification Design

The gamification strategy of the current research is based on the Pyramidal Gamification Design Model offered by Werbach and Hunter (2012). In this model, gamification elements are grouped into three main categories. Figure 1 shows a diagram of the Pyramidal Gamification Design Model.

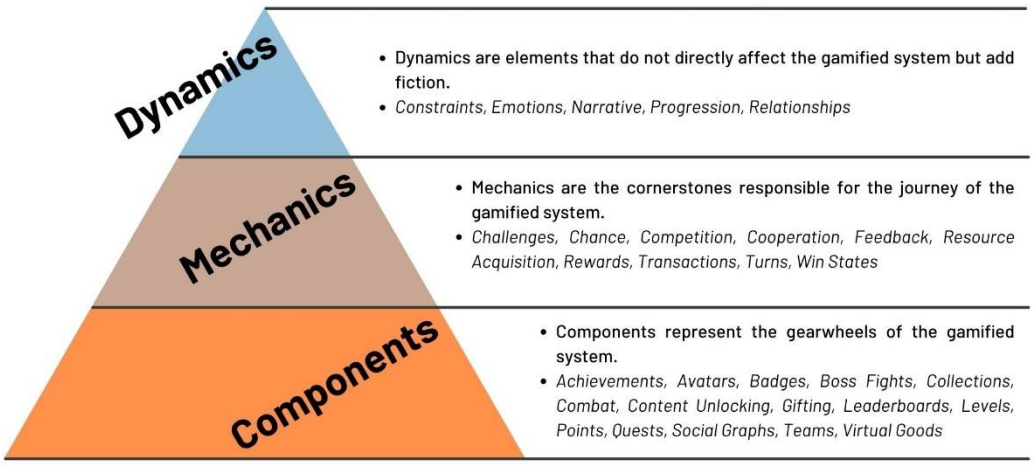

Figure 1. Pyramidal gamification design model

Figure 1 shows the main and sub-categories of the Pyramidal Gamification Design Model. The model consists of the categories Dynamics, Mechanics and Components. Dynamics act as the emotional elements of the gamification process, while Mechanics act as the elements related to the rules of the process. The elements of the components group, which is the basic group of the process, are the most prominent in the gamification process. Furthermore, the Pyramidal Gamification Design Model has the advantage of being adaptable to different research fields and study groups (Werbach & Hunter, 2012). Since the objective of the current research is related to the use of gamification elements by embodying them, the Pyramidal Gamification Design Model was considered appropriate as a gamification design. Table 1 displays the elements selected compatibly with the research aim.

Table 1. Preferred elements and their functions.

Element	Function
Avatar	The visual element that represents the student profile in the gamified process.
Badge	The visual element that students acquire according to their performance.
Collection Table	The personal file element contains items collected by students during the process.
Level	The element that expresses students' level of expertise in the process.
Progress Bar	The element that indicates the level of completion of the student's current level.

Table 1 shows the gamification elements operated in the research and their functions in the process. Avatar, badge, level, progress bar, and collection elements are the most commonly preferred elements in educational gamification systems (Ekici, 2021; Manzano Leon et al., 2021). The Components category in the Pyramidal Gamification Design Model includes the most distinct and dominant elements of gamification (Bozkurt & Genç Kumtepe, 2014; Werbach & Hunter, 2012). For this reason, these elements were selected for the embodiment process in line with the research purpose. Embodiment procedures were designed to be appropriate for the age level of the study group (age 10 years). These

elements selected for the implementation process were brought together within the framework of the collection table element. The design of the tangible collection table element is shown in Figure 2.

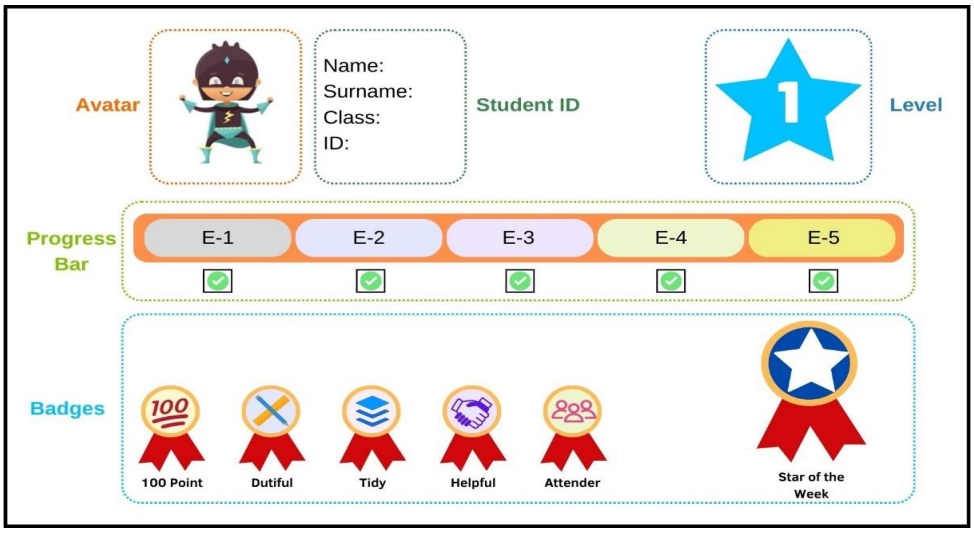

Figure 2. Sample of collection table design

Figure 2 shows the location of the tangible elements on the collection table element. The collection table was distributed to each student as an individual portfolio file before the implementation process. Students were asked to keep this personal portfolio file throughout the process. It was thought that the individualised use of this element would increase students' sense of commitment to the implementation process.

At the bottom of the collection table, there is a section for badges. The badge element is a popular gamification element among researchers (Indriasari et al., 2020; Nadi Ravandi & Batooli, 2022). In gamified processes, badges provide visual feedback to students based on their achievements (Werbach & Hunter, 2012). Tangible badges were distributed based on students' achievements and affixed to the collection table. Figure 3 displays the specially designed badges used in the study and their functions within the application.

Figure 3. The tangible badges and their functions

Figure 3 shows the tangible badges used in the implementation process and their functions. The gamification design of the research was designed free of elements that might imply competition or race to avoid the phenomenon of a loser. Badges such as tidy, teammate, and attender were included in the process, which can be earned by each student regardless of their performance in the mathematics course. Additionally, the leaderboard element is frequently used in gamification processes and each player is ranked according to their total scores in the gamified process by this element. In this study, the leaderboard element was not included in the gamification design of this research. Thus, it was intended to keep students away from the harmful effects of competition and to ensure that they participate in the process with more self-confidence.

Implementation Process

The study was implemented over 11 weeks, including one pilot test week. The initial week was designated as the pilot test week. The practice of the pilot test week was aimed at the students to overcome their inexperience regarding the implementation procedure. It was considered that this application would contribute to the research reliability. All data related to the pilot week were excluded from the research data set. The pilot week began with an explanation of the process rules to the students. Following this, each student received their portfolio files containing collection tables before the implementation. To increase their sense of belonging to the implementation process, students were asked to keep these files.

Following the process, students received explanations about the tangible elements and their tasks. Throughout the pilot test week, they were also requested to select avatars to represent themselves. These avatars were then added to the students' collection table. Additionally, students were required to maintain a weekly diary to write down their thoughts during the implementation process. Students were instructed to record their experiences and opinions gained during the process in these diaries.

The implementation process was limited to the mathematics course, following the fifth-grade mathematics curriculum (Ministry of National Education, 2018). Individual feedback on the implementation process was provided to each student during the last math lesson of each week and recorded in collection tables. Figure 4 shows an example of a completed weekly individual feedback table.

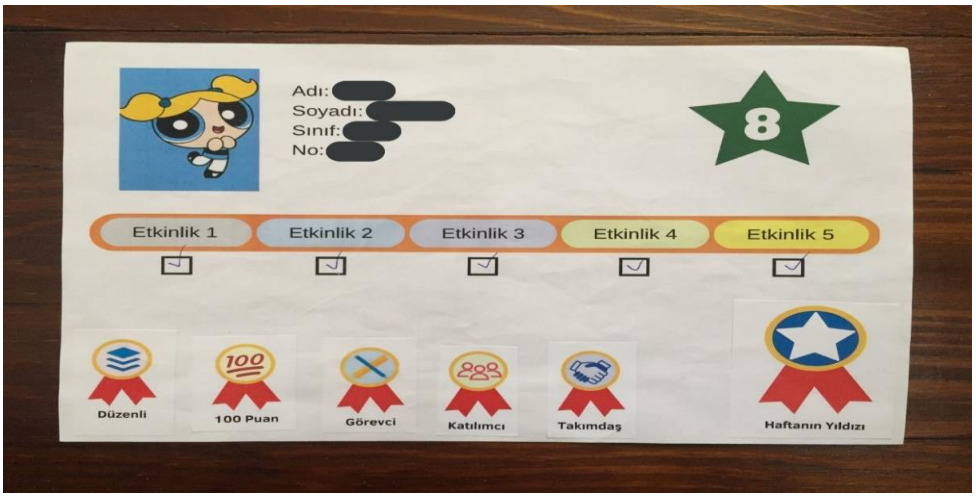

Figure 4. Sample of individual collection tables

Figure 4 displays the collection table of a student from the study group. The students' levels and progress bars were enhanced based on individual feedback. As a result, badges earned by each student according to their performance were added to their collection tables weekly. All planned elements were fully utilised during the implementation process.

Data Collections

The focus group interview approach was selected as a data collection strategy in this research. This method involves consulting the opinions of a small group of individuals on a specific issue (Merriam, 2009). The focus group interview method aims to collect more meaningful data on the subject being discussed through the interaction of group members (Patton, 2002). This method is advantageous in research where group members share similar experiences (Creswell, 2012). As the students in the study group are of the same age (10 years old) and have gained experience with the research application in the same classroom environment, the focus group interview approach was chosen as the primary data collection method for the research.

The study employed a semi-structured focus group interview form as the primary data collection instrument. The form was developed by the researchers concerning relevant literature and aimed to determine the perspectives of students on the tangible gamification elements in line with the research purpose. Following the determination of the questions in the draft form, the opinions of seven experts with doctoral degrees in Educational Sciences were sought. The necessary adjustments were made based on experts' evaluations. After determining the questions, a pilot study was conducted to test the suitability of the form (suitability of the questions to the students, the time required for the interviews, the timing of the probing questions, etc.) for the research's purpose and the interview process. The interview form was revised and finalised after this stage.

Focus group interviews were carried out with 10 students who were randomly chosen from the study group. To obtain more comprehensive data from the interviews, the students were divided into two groups of five students each. The interviews were conducted separately with each group. During the focus group discussions, a set of procedures and ethical principles were followed (Krueger, 1997). The students were notified that their interview data would remain confidential. The interviews took place in an empty classroom to ensure the students' comfort and familiarity. The researcher obtained permission from the students to record the interviews and kept notes during the process. Each group were kept separate until the interviews were completed.

In this research, data triangulation was employed by using multiple data collection methods, including focus group interviews, researcher observation notes, and student diaries. Data triangulation means that more credible inferences can be made by comparing the data obtained by using more than one data collection method (Merriam, 2009). Interviews, observations, and text analysis methods are frequently used together to triangulate data in behavioural sciences (Merriam, 2009). In this study, researcher observation notes and data collected through student diaries were used to triangulate the data obtained from focus group interviews.

During the implementation process, the researcher took observation notes after each lesson and collected weekly student diaries. The students were

asked to provide their impression of the implementation process in their diaries throughout the week. The data collection process, based on observation notes and student diaries, continued throughout the implementation period. All students in the study group participated in the student diary application throughout the research process. A total of 253 diary documents were collected. Twenty-three of these documents were left off from the data set as they related to the first implementation week (the pilot test week). The data collection process was completed with focus group interviews carried out after the implementation of the research.

Data Analysis

The study employed content analysis to examine the interview data. Content analysis is a systematic process for interpreting the collected data (Merriam, 2009). Content analysis aims to systematically evaluate concepts and their relationships from raw data (Yıldırım & Şimşek, 2016). Content analysis is an advantageous method for analysing data from sources such as interview transcripts, field notes, diaries, and documents (Patton, 2002). Accordingly, the content analysis method was preferred to analyse the data collected from the focus group interviews in this study.

The process of content analysis began by transcribing the video recordings of the focus group interviews into text format. After that, the units of analysis were determined, and the data coding stage was initiated. Draft themes were then identified for the data, and the analysis process continued by associating the data with the themes. Finally, the draft themes were finalised, and they were associated with the research purpose. The analysis process was summarised and controlled before completing the content analysis.

The study employed the intercoder reliability formula to assess the consistency of themes generated while conducting content analysis and the reliability of code distribution to those themes. Intercoder reliability is a control formula that was used to examine the compatibility between different coding processes of the same data set in content analysis (Miles & Huberman, 1994). This method involves coding the same dataset by different researchers and assessing the consistency between the initial coding and the subsequent coding. The reliability value is determined by the ratio of the number of agreed statements to the total number of statements. It is recommended that the intercoder reliability value should be at least 80% (Miles & Huberman, 1994). The study's content analysis results were presented to experts in the field of Educational Sciences for evaluation. The intercoder reliability value was calculated for each expert, and no value below 80% was found. The mean of these percentages was calculated as 92.85%.

The text analysis method was used for student diaries and researcher notes. This method involves examining written or visual materials related to the concept under investigation (Yıldırım & Şimşek, 2016). The written documents were analysed and those containing relevant data for the research were selected as input for this study. Additionally, video recordings of the focus group interviews were analysed to provide supplementary data sources for the research. The video recordings were analysed to identify any student behaviours that may have been overlooked. This stage constituted the final stage of the data analysis process.

Results

The study aimed to determine the perspectives of fifth-grade secondary school students on tangible gamification elements. This section presents the results of the data analysis of the focus group interview data, researcher notes and student diaries collected during the research. Table 2 displays the themes and sub-themes concerning student perspectives on gamification elements.

Table 2. Student perspectives on the tangible gamification elements.

Themes	Group	Sub-themes
Avatar	Positive	Developing a sense of belonging Embellishing
	Negative/Revision required	Not a must Not beneficial
Badge	Positive	Visually impressive Blissful Exciting
	Negative/Revision required	Few in number Thicker material should be made of Small in size
Collection Table	Positive	Cause of stress and anxiety Distractor Nice to be individual features Organizer
	Negative/Revision required	The definition of function should be clarified Written explanations should appear
Level	Positive	Honorific Intriguing
	Negative/Revision required	Visuals should be diversified Categorical titles should be added
Progress Bar	Positive	Status notifier Anti-clutter
	Negative/Revision required	Content should be improved More individual areas should be included

Table 2 presents the themes and sub-themes that were identified from the analysis of student perspectives. Themes were specifically created for each element. The sub-themes are categorised into two groups: positive and negative/revision required.

Avatar Element Perspectives

Some students stated that using the avatar element increased the visual appeal of the process. It was also stated that it improves the sense of belonging.

"I think it embellished the process. I liked my avatar and I was happy to have it with me."

"I can say that my avatar made my collection table feel like my own. Generally, I believe that it was a positive experience."

Furthermore, some students believe that the avatar element is unnecessary and does not significantly contribute to the process.

“I do not believe that having an avatar is essential. If I did not have one, it would not make much of a difference to me.”

“I believe that I could do without it. I do not think my avatar provides quite an advantage for me.”

Badge Element Perspectives

Some of the students reported that collecting badges was exciting and made the lesson enjoyable. They appreciated the visually appealing badge designs and the effort required to collect them.

“Especially, the badges were visually impressive. I liked their colours and the designs.”

“Striving for badges was a pleasure.”

“Earning all the badges was an exciting feeling.”

Some students believed that the use of badges was positive, but they suggested that some features needed revision. They proposed using more badges to make the process more exciting. Additionally, they suggested that badges made of more durable material and larger sizes would enhance the user experience.

“I think it would be exciting if there were more badges.”

“The colours of the badges were satisfactory, but the sizes on the collection table seemed a bit small.”

“I believe that it would have been more beneficial if the badges were made of thicker material for better durability and storage.”

Additionally, some students reported negative opinions about badges, and referred to them as a waste of time, distracting, and a source of stress.

“I was distracted by the large number of badges. I think it was a waste of time for me.”

“Because of the badges, we had to succeed again and again each week. This situation caused me some stress.”

Collection Table Element Perspectives

Several students were mostly positive about the collection table element. They stated that this element has a basic task that brings the other elements together and adds order to the process. The students expressed satisfaction with retaining their collection table and reported feeling proud to showcase it to their families at home.

“The best thing about the collection table was, of course, showing it to my family.”

“It brought order, like a table on which all other things are arranged.”

In addition, some students stated that the collection table should be revised.

“At first, I did not understand its function, but later I clearly understood it.”

“It would be more explanatory if there were written explanations on it.”

Level Element Perspectives

The level element was considered motivating by several students. They also reported that it was flattering to see their experience level in the process by this element.

“It was an honour to strive for and reach the final level.”

“I was eager to reach the final level quickly.”

Additionally, some students stated that the level element should be improved visually and contextually.

“I think it would be better if there were levels with names such as ‘novice’, ‘master’, and ‘expert’ in addition to the existing stars.”

“I think that accompanying the levels with a message such as ‘well done’, ‘bravo’, or ‘congratulations’ would be better.”

“It would be better if the shape did not always change to stars but to a flower, cloud or heart.”

Progress Bar Element Perspectives

Several students stated that the progress bar element is convenient in terms of indicating which activity they are lacking each week. Additionally, the progress bar element is advantageous in terms of facilitating the follow-up of the activities and easily seeing which activity is next.

“The progress bar indicated the next activity, preventing any confusion between activities.”

“It informed me how many events were left to the next level. As the progress bar filled up, I felt closer to reaching the next level.”

Some students did not consider the progress bar element necessary and suggested visual improvements. Some of the remaining ones stated that the current design could benefit from additional details.

“It would be better if there were more boxes. I think there could have been separate boxes for both activities and badges.”

“It would be better if there was an area for notes so that we could write down our shortcomings. In addition, it would be even better if there was a teacher’s signature on it.”

“Expressing the progress through the use of crayons would have been more effective.”

“I would prefer the progress bar should move as badges are collected, rather than as activities are completed.”

Perspectives on Elements Tangibility

During the focus group interviews, students were asked about their perspectives on the tangibility of the elements. They expressed that having tangible elements was advantageous as they could access them anytime and anywhere without the need for digital devices or connections. The students also stated that they were pleased that the elements were portable.

“I think that was an advantage because we could follow the process from anywhere without any equipment.”

"I think it was nice to be able to touch and move the elements, I felt they were mine."

Student Diaries and Observations Results

To triangulate the data obtained from the focus group interviews, the researcher observation notes and the student diaries specifically requested for each week during the implementation process were used. Thus, it was aimed to interpret the research results more clearly and to reach more accurate inferences. A total of 253 diary documents were collected from the students for 11 weeks. Since 23 of these diaries were related to the pilot test week, they were not included in the analysis. After analysing the remaining 230 diary documents with text analysis, the results confirmed the data gathered from the focus group interviews. These results indicated that the tangible gamification process was both exciting and motivating for the students, as they had mentioned in their interviews. Some of these statements are as below.

"I collected all the badges this week. I am so excited for next week!"

"It was great to show my collection table to my family!"

Discussion

This study aims to examine secondary school students' perspectives on tangible gamification elements. For this purpose, the gamification elements embodied with traditional pen-paper methods were designed according to the characteristics of the study group. These elements were included in the mathematics course learning environment for 11 weeks, including a pilot test week. The present study employed the case study design which is defined as one of the qualitative research models. The focus group interview method was used as the primary data collection method. Additionally, the researcher notes and student diaries were used for data triangulation. The results indicate that while students have the majority of positive perspectives toward the tangible gamification elements, the existing elements need a set of revisions.

The students think that the tangible gamification elements are exciting and blissful. The results obtained from document analysis, based on researcher notes and student diaries, confirm these perspectives of the students. Students reported that their experiences with the elements were positive and that they would like to continue using the elements after a set of revisions. It is estimated that these positive opinions originate from the design of the elements, their suitability for the age level and their practical use in the learning environment. Furthermore, the tangibility and individuality of the elements were found to enhance students' sense of belonging to the gamified process. Additionally, the colourful designs of the elements not only attracted attention but also motivated students' feelings of excitement and curiosity. These results are supported by the results from researcher notes and student diaries. Therefore, it is believed that the tangible gamification elements provided a unique non-digital experience and attracted the attention of students accustomed to the routine of digital devices.

The students identified several revision requirements for the elements, mostly related to their visual presentation and content. They believe that implementing these revisions could result in a more personalised and useful system. Furthermore, certain students expressed negative opinions,

citing stress/anxiety and distraction, particularly about the badges. Considering that the badge is one of the most preferred and evaluated positive element in educational gamification (Indriasari et al., 2020; Author, 2019; Nadi Ravandi & Batooli, 2022; Ortega Arranz, Er et al., 2019), these negative expressions are the unexpected and surprising result of the study. Additionally, the researcher notes and student diaries indicate that students experience stress occasionally. The leaderboard element ranks participants according to their scores in the gamified process. Therefore, the study excluded the leaderboard element to protect students from the negativity of competition. Furthermore, the badges that each student can earn regardless of their academic success in mathematics were also included to avoid the phenomenon of 'loser'. However, it is believed that the role descriptions of the badges that were used in the study, or classroom activities such as math quizzes, may have led students into a latent competition. Further studies are required to investigate these ambiguities.

The main conclusion that can be reached from the research results is that educational gamification can also provide positive experiences to students when used apart from digital platforms. Tangible gamification elements designed by the age and cognitive level of the study group can be a practical application that is occasionally used against digital monotony in the classroom. The current study results show that there is a need for more individualised designs for the use of tangible gamification elements in educational environments. More dynamic designs to reduce students' stress and anxiety levels related to the gamified process can be beneficial. The results of the current study are in line with the results of Dodero et al. (2014), Gennari et al. (2017), Author (2019), and Xiao and Hew (2023). Present results are also partially consistent with the results of Ortega Arranz, Bote Lorenzo et al. (2019) and Bai et al. (2021).

Conclusion, Limitations and Recommendations

This study aims to investigate the perspectives of secondary school students regarding tangible gamification elements. The main results of the study show that the students are generally pleased with the tangible gamification elements and their perspectives are mostly positive. Furthermore, the research suggests that more appropriate designs can be developed through a set of revisions to tangible elements. In this respect, the present study is considered that it can shed new light on the use of educational gamification.

The present study has some limitations. The study group of this research consisted of only 23 students from the fifth grade (age 10 years) level. Additionally, the study only implemented elements selected from the Pyramidal Gamification Design Model (Werbach & Hunter, 2012) that were adapted for the study group. These elements were solely used in the scope of the mathematics course, which the students attended for five sessions per week. Moreover, the implementation period of the study lasted for 11 weeks, including a pilot test week. It is worth noting that these limitations may have influenced the students' perceptions of the tangible elements. Therefore, it is clear that future studies should address these limitations.

This research provides an instance and guide for using tangible gamification elements in learning environments and presents research opportunities for future studies. Initially, exploring embodiment

applications related to different gamification design models can contribute to the educational gamification literature. It is believed that implementing current research practices in other disciplines can provide important results. Additionally, further research with larger study groups and longer-term implementations is necessary to confirm the results of this research.

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Conflict of Interest

There is no conflict of interest between the authors and the institutions.

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