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Gamification's efficacy in enhancing students' HTML programming skills and academic achievement motivation

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Abstract

This study aims to demonstrate the efficacy of gamification in developing HTML programming skills and academic achievement motivation for 10th-grade students. Despite the significance of computer programming in developing students' thinking, many students still need more motivation to learn it. One of the entertaining strategies of computer programming is gamification. The study used a quasi-experimental design for two groups. The experimental group (N=18) was taught by gamification and the control group (N=17) was taught by the traditional teaching method. The researcher conducted a pre-test to determine the equivalence between groups using a valid and reliable practical test and scale. After three-weeks of teaching, the same test and scale were applied to compare the groups. The result showed statistical differences between the two groups in favor of the experimental group in programming skills and all academic achievement motivation dimensions. This study recommended that using gamification in teaching programming languages to students at different stages would help computer teachers. More research should be conducted to investigate the impact of gamification on teaching different programming languages.

Keywords: Academic achievement motivation, Digital technology course, Gamification, HTML teaching, Motivation, Programming education, Programming skills, Saudi 2030 vision.

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Contents

Contribution of this paper to the literature

This study adds to the body of knowledge on adopting gamification in programming language education. After reviewing the literature, a few studies investigated the use of gamification in developing HTML programming skills and academic achievement motivation using an experimental design in Arab countries. Further, this study showed steps on how to use gamification in a classroom.

1. Introduction

Nowadays, programming education is an important topic to provide the learner with problem-solving skills and develop research skills. It also enhances collaborative learning skills, logical, creative, computational thinking and self-efficacy for learners (Psycharis & Kallia, 2017; Zhan et al., 2022). *Programming skills* are defined as the learner's ability to write a series of commands and instructions in a programming language in an orderly and sequential manner with high accuracy, speed and mastery (Alastal, Akl, & Al-Agha, 2021).

The Kingdom of Saudi Arabia has sought to create human cadres with the technological and programming skills necessary for the labor market through its development vision (2030). As a result, many initiatives have been launched such as the "future skills" initiative, the "Technology Pioneers" program, the "Hemmah Camp for Software Development" and the "Saudi Programs" initiative to train Saudi youth on computer programming languages such as JavaScript and Python. It also organized the "Promising Programmer" competition which has been directed to primary and intermediate students to increase students' awareness regarding the importance of computer programming and enhance their programming skills from an early age so that they will have a positive attitude towards it (Vision 2030 Kingdom of Saudi Arabia, 2016). Programming has been included in digital technology curricula at all school stages to teach students how to think logically, solve problems, understand algorithms and write computer programs using different programming languages.

Despite the educational importance of programming skills, their acquisition is affected by many factors such as learners' motivation which influences their learning. According to Alqarni and Imran (2021), it is suggested that measures be taken to stimulate motivation for achieving educational goals among students towards learning computer programming. Novice students learning computer programming face challenges in perceiving abstract knowledge and programming codes which weaken their enthusiasm and desire to learn them (Mubin, Poh, & Jantan, 2020; Pinto & Terroso, 2022). So, it is necessary to pay attention to the factors that positively affect learners' motivation and drive them to complete programming tasks (Jenkins, 2001; Topalli & Cagiltay, 2018). According to Tolba (2021), academic achievement motivation is considered one of the crucial aspects of human motivation in maintaining the learners' behavior and making them oriented towards achieving the goal and capable of completing challenging tasks quickly and proficiently.

Khalifa (2006) mentioned that the educational context plays a vital role in stimulating the learner's motivation. This is also confirmed by Alrabighi (2015) who indicated that by employing modern strategies and techniques in the educational process that provide an educational environment, it can be used to stimulate the learner's academic achievement motivation and increase their curiosity to learn which does not only depend on lecturing and memorization. One recent trend in education is gamification which applies game mechanics and game design techniques to motivate learners to achieve educational goals (Sailer, Hense, Mayr, & Mandl, 2017). Therefore, it goes beyond just playing for entertainment to employing gamification elements to achieve educational goals and provide a motivating environment for students to learn (Chapman & Rich, 2018; Yildirim, 2017). The essence of gamification depends on using game elements such as points, badges, levels and leaderboards to create a competitive environment that directs learner behavior and motivates them towards learning (Schöbel et al., 2020). Muntean (2011) indicated that gamification combines external motivation with internal motivation. External motivation is represented by rewards, collecting points or level progress. In contrast, internal motivation is represented in the desire for accomplishments, mastery, the spirit of competition and interaction with others.

The current research sought to identify the effectiveness of gamification in developing programming skills and academic achievement motivation in the digital technology course for high school students.

2. Research Problem

Despite the educational importance of programming skills, previous studies indicate a decline and deficiency in students' acquisition of programming skills. Maryono, Budiyono, and Akhyar (2022); Elshiekh and Butgerit (2017) and Khaleel, Ashaari, and Wook (2019) indicate the difficulty in teaching and learning programming languages because of abstract knowledge. Xia and Liitiäinen (2017) and Alsaeed (2020) also confirmed a decline in the student's ability to write syntax. From their point of view, this was attributed to the traditional methods used in teaching programming lessons in computer courses. Alsaeed (2020) also agreed that the traditional methods used in teaching web design programming, such as HyperText Markup Language (HTML) caused poor acquisition of programming skills. According to Alsaeed (2020), teaching HTML requires appropriate teaching strategies and modern technologies to develop and increase students' comprehension.

Through their teaching experience with the Computer and Technology book, the researchers noticed that the programming unit is the most challenging and students often need help understanding and assimilating it. Several interviews were conducted with computer supervisors who indicated a decline in computer skills (particularly programming) among students. According to the supervisors, one reason for this decline is using teaching methods that are incompatible with the nature of programming skills. The researchers examined a sample of lesson plans for some computer teachers to accurately identify the most common teaching strategy for programming skills. They noted that the flipped classroom, self-learning and practical demonstration strategies are the most common teaching strategies computer teachers adopt. However, teaching programming skills requires methods and strategies that combine stimulating the learner's motivation towards programming learning and simplifying it into logically sequential levels and skills to make it easier for the learner to understand. Gamification is one example of a strategy that maintains students' motivation (Ardiana & Loekito, 2020; Scott & Dalton, 2021). In addition to the above, recent studies have emphasized the importance of further research

regarding gamification in programming education (Khaleel et al., 2019; Zhan et al., 2022).

2.1. Research Questions

1. To what extent does adopting gamification affect the development of HTML programming skills for 10th-grade students in the digital technology course?
2. To what extent does adopting gamification in a classroom affect 10th-grade students' academic achievement and motivation in the digital technology course?

2.2. Research Hypotheses

1. *There are no statistical differences between the control and experimental groups at $p \leq 0.05$ in the programming skills post-test attributed to gamification.*
2. *There are no statistical differences between the control and experimental groups at $p \leq 0.05$ in the academic achievement motivation attributed to gamification.*

2.3. Research Significance

After reviewing the literature, it was noted that there is a research gap in using gamification to develop HTML programming skills and academic achievement motivation. This research could encourage other researchers to investigate the relationship among programming skills, academic achievement and gamification in different contexts and populations. This research would encourage teachers to learn more about gamification and how they can apply it in their classrooms. Furthermore, this research can draw educational supervisors' attention to the importance of providing professional development for teachers about gamification and how to employ it in teaching. In addition, this study may motivate curriculum designers and educational development companies to develop and produce electronic applications designed according to gamification principles and compatible with the curriculum.

3. Literature Review

3.1. Gamification Definition

The gamification concept uses game elements to improve learners' experiences and motivate them to participate (Deterding, Dixon, Khaled, & Nacke, 2011). Thus, gamification goes beyond just playing for entertainment to employing its elements to achieve educational objectives (Chapman & Rich, 2018). Zichermann and Cunningham (2011) indicate that gamification uses game concepts and mechanics to stimulate learners' motivation to engage in problem-solving. Kim, Song, Lockee, and Burton (2018) state that gamification is an educational approach based on activities and procedures that use games' elements and mechanisms to achieve a goal or solve a problem and aims to maintain students' motivation and enhance their skills. Kim et al. (2018) indicate that gamification is a set of systematic activities to achieve a specific goal that not only uses game components such as badges and points but also integrates game mechanics, such as competition and challenge and feedback into the learning context. Furthermore, Llorens-Largo et al. (2016) defined gamification as using strategies, models, dynamics, mechanics and game elements in non-game contexts to convey a message or content or to change behavior through a playful experience that enhances motivation, engagement and fun. According to Kapp (2012), gamification is the use of mechanisms, aesthetic values and ideas for play to improve levels of engagement and motivation and enhance learning processes and problem-solving skills. Gamification is an effective strategy for accelerating the acquisition of educational experience, teaching complex materials and developing systemic thinking. It also helps acquire skills and knowledge quickly and enhances learning retention compared to traditional education. Gamification seeks to integrate with educational content to provide authentic learning that contributes to organizing the learning process and engaging in learning thoroughly. Moreover, Kapp (2012) adds that the design of educational games is complex and requires expertise and specialized designers, unlike gamification which is easy to design and does not require unique or complex skills to be employed in the educational process.

3.2. Gamification Elements

By reviewing the literature, there are many game elements that can be employed in the education context. The most common are: points, leaderboards, badges, levels, progress bars, characters, challenges, tasks, goal setting and rewards (Hamari, Koivisto, & Sarsa, 2014; Riar, Morschheuser, Zarnekow, & Hamari, 2022; Zichermann & Cunningham, 2011). This study has employed a specific set of elements since they are visible to the learners and easily activated in the experimental study (Sailer et al., 2017). The game elements adopted in this study are as follows:

Point: Points are the most common gamification element used to provide feedback to the learner. The learner obtains it by completing specific activities or tasks (Zichermann & Linder, 2013).

Leaderboard: The leaderboard is a visual display that indicates the level of the learner's accomplishment compared to others by displaying the rank of the learners according to their points and the scores obtained from goals achieved which generates competition between them as learners seek to reach the top of the rank (Christy & Fox, 2014).

Levels: Levels define the point at which a learner achieves specific educational tasks. The learner can only move from one level to another after completing all the current level tasks as the levels are gradual. When completing specific points and acquiring knowledge and skills, the learner moves to the next level. Therefore, this element displays the learner's learning progress (Martens & Muller, 2017).

Badges: A set of visual representations or symbols given to learners after completing several specific tasks obtaining a certain number of points or passing to the next level. It is a reward offered to the learner upon achieving a distinguished accomplishment (Riar et al., 2022).

Progress Bar: It is a visual representation in the form of graphs or diagrams that shows the extent of learners' progress towards achieving the goal and the amount of accomplishment of the tasks assigned to them (Riar et al., 2022).

Rewards: The aim of rewards is to enhance the learner's motivation to achieve and repeat a desired behavior. It can be material or moral obtained by the learner from completing specific tasks such as obtaining a virtual character, a badge or additional points (Riar et al., 2022).

Avatars: This is a visual representation of the learner's character within the game. It aims to increase social engagement by allowing each student to adopt new identities and roles and make crucial decisions within the game from an unfamiliar point of view (Oxford Analytica, 2016). Some gamification applications allow users to create a profile with academic achievements to share with other students and the external community (Oxford Analytica, 2016).

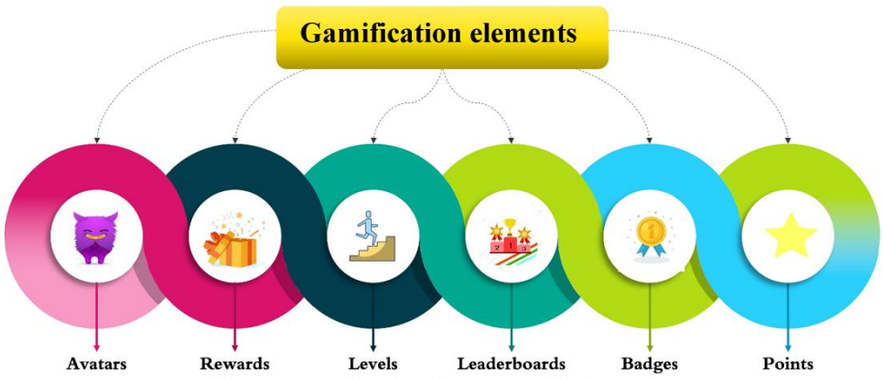

Figure 1. Gamification elements used in the study.

3.3. Advantages of Adopting Gamification for Learning

Gamification is a distinct method in the educational process that provides a cognitively stimulating and socially integrated learning experience through its various elements and applications in education. It enhances learners' skills and helps achieve better learning by integrating enjoyment and fun with learning, developing internal motivation that promotes continuous self-learning. It also helps learners communicate and cooperate with others, develop creative thinking, achieve self-efficacy, refine critical thinking skills and promote self-responsibility (Fischer & Barabasch, 2020).

Further, Kapp (2012) highlights several advantages of gamification in an educational context. According to him, gamification can enhance students' self-regulated learning skills and direct them to achieve their goals despite difficulties and challenges. Gamification also provides immediate feedback on the learner's progress and activity which contributes to increasing learners' motivation and involvement in learning. It also allows learners to create their own educational experiences by completing specific tasks and getting rewards.

Gamification is based on multiple learning theories such as constructivism and behaviorism (Barneva, Kanev, Kapralos, Jenkin, & Brimkov, 2017; Majuri, Koivisto, & Hamari, 2018). The constructivist theory relies on activating learners' roles and making them the center of the educational process. Learning is an active and positive process through which one learns new concepts and knowledge and links them to previous knowledge and experiences. Constructivism is consistent with the foundations of gamification where tasks should range from easy to complex. There is competition and a challenge in completing learning tasks. Moreover, gamification is linked to the main principle of behaviorism which is reinforcement through points, rewards and badges for desired behaviors.

Deci and Ryan (2000) indicated that gamification is linked to the self-determination theory related to human motivation. It describes the behavior of individuals through three main elements: competence, independence and affiliation. Competence is linked to motivation towards overcoming difficulties and challenges and achieving success and autonomy is related to willpower, decision-making and the desire to take responsibility. Affiliation is the desire to associate with others in cooperative work groups and teams dominated by respect and mutual dependence. According to Kim et al. (2018), the relationship between the independence principle of self-determination and gamification appears by allowing the learner to set learning goals and accomplish multiple tasks. As far as the competence principle is concerned, the learner feels competent during gamification by achieving learning goals moving from one level to another obtaining gamification levels and receiving continuous feedback. Regarding the affiliation principle, gamification is possible by providing opportunities to discover and join learning communities and to develop different ways of competition, collaboration and discussion.

3.4. Computer Programming Skills

Many educational institutions in various countries have been interested in teaching programming as an introductory course. The United States of America has integrated programming into the curricula at the primary and secondary levels. It is viewed internationally as an essential skill that must be developed. Computer programming effectively develops creative thinking, problem-solving skills and logical and abstract thinking skills and supports the skills of the twenty-first century in individuals such as communication, working in a team and decision-making quickly and efficiently (Kert & Erkoç, 2017; Tsai & Lai, 2022). Programming is one of the most challenging topics in computer science and information technology. Students often experience difficulties understanding it because the knowledge and concepts contained in programming languages are primarily abstract knowledge and concepts. Students must possess problem-solving, analytical thinking, arithmetic and logical skills. Therefore, many students show low motivation towards learning it, especially beginners in computer programming (Ismail, Ngah, & Umar, 2010; Mohorovicic & Strcic, 2011; Queirós, 2019; Tsai & Lai, 2022).

Xia and Liitiäinen (2017) stated that picking the appropriate teaching method is essential to improve students' programming skills. However, according to Queirós (2019), the teaching methods used to teach programming are lecturing methods in which the programming language syntax is presented theoretically without allowing students to practice programming skills. Biju (2018) stated that teaching programming languages in a traditional theoretical manner leads to a gap between learning and applying programming concepts and restricts the learner's problem-

solving skills. Therefore, Biju (2018) called for the importance of learning programming by asking students to immediately apply the concepts and knowledge learned, adopt project-based learning and write a report reflecting on the learning at the end of the course.

Alabbadi and Qureshi (2016) added that instructors initially have to identify the intended programming knowledge and skills to be achieved at the end of the lesson which is a necessary step in any educational process. In addition, it is essential to select teaching methods that provide immediate feedback to students while they perform skills and decrease the perceived difficulty of programming (Butler & Morgan, 2007). Furthermore, it is vital to use appropriate teaching methods that provide students with a more efficient learning environment (Ismail et al., 2010; Mohorovicic & Strcic, 2011). Sarpong, Arthur, and Amoako (2013) indicated that choosing suitable teaching strategies, such as problem-based learning, project-based learning and laboratory practical application along with lecturing to teach programming, stimulates students' motivation and encourages self-engagement. These strategies are the most effective in the field of teaching programming. Sarpong et al. (2013) recommend combining many teaching strategies encourage students to obtain many opportunities and adapt to the best teaching practices.

3.5. Academic Achievement Motivation

Academic performance is one of the most critical priorities in education. Academic performance refers to the extent to which a student, teacher or institution achieves the desired and planned educational goals (Zambuk, 2021). Academic achievement motivation is a psychological factor that plays an essential role in raising or lowering academic performance. (Zambuk, 2021) defined as the individual's continuous effort to achieve success with a certain level of excellence in competitive situations (Mamin, Hasanuddinl;v, & Samputri, 2020). It arises within students until they can learn, do assignments, solve problems, move and direct themselves to achieve the desired achievements (Mamin et al., 2020). Heckhausen (1968) believes that achievement motivation encourages the person to improve his ability and maintain it at the highest possible level in each activity in which the criterion of excellence is used as a comparison. It significantly determines students' educational attainment and functional performance (McClelland, 2000; Steinmayr, Weidinger, Schwinger, & Spinath, 2019). It also affects students' future success or failure since the reason for achieving learning outcomes is often solid motivation (Mahato & Barman, 2019; Sikhwari, 2014; Wiyono & Wu, 2022; Zambuk, 2021).

Achievement motivation is the learners' desire to achieve excellence (Dwijuliani, Rijanto, Nurlaela, & Basuki, 2021). The measure of excellence is determined by comparing a learner's achievements to other learners' or previous accomplishments. According to Dwijuliani et al. (2021), achievement motivation is the ability that comes from itself to achieve success efficiently and get maximum results. Thus, students' success in achieving high educational results is determined by their academic achievement motivation (Ly, Degeng, Setyosari, & Sulton, 2016). There are several previous studies that indicate that there is a relationship between academic achievement motivation, programming skills and gamification. Cuervo-Cely, Restrepo-Calle, and Ramírez-Echeverry (2022) investigated the impact of using computer gamification on students' motivation towards learning computer programming in an introductory programming course using experimental design. The results indicated that gamification positively influenced students' self-confidence and expectations to achieve their learning goals and desire to learn. The study recommended that teachers use gamified tools for teaching computer programming.

Moreover, Zhan et al. (2022) conducted a meta-analysis involving 21 research to explore the effect of adopting gamification on learning computer programming. The results confirmed that gamification positively impacts students' motivation and academic achievement followed by thinking skills. The least positive effect is on students' cognition. The results recommended that more research is needed to investigate gamification and its influence on programming education. Furthermore, Maryono et al. (2022) conducted a systematic literature review involving 41 research to determine the most significant challenges students face when learning computer programming. Many studies indicated that students need more motivation and engagement towards programming learning and help understanding programming concepts. On the other hand, the researcher found that adopting gamification leads to more motivation and engagement, a better understanding of programming concepts and an improvement in students' programming skills.

After reviewing the literature and previous studies on academic achievement motivation, it turns out that there is disagreement among researchers about the definition and numbers of academic achievement motivation dimensions (Alsalami, 2019; Hermans, 1970; Khalifa, 2006). In light of the previous studies, this study adopted the following dimensions of academic achievement motivation: the desire to excel and succeed goal orientation, academic persistence, academic competition, academic achievement behavior and enjoyment of programming.

3.6. Study Design

The current research aims to reveal the effectiveness of gamification in developing programming skills and academic achievement motivation in the digital technology course for 10th-grade students. The researchers used a quasi-experimental design with two groups to achieve this goal. The experimental group was taught the "programming using HTML" unit in digital technology using gamification. The control group was taught the same unit using the traditional teaching method. The programming skills test and academic achievement motivation scale were applied to both groups before and after teaching the unit. Figure 2 shows the experimental design.

3.7. Sampling

A convenience sample was chosen from 10th-grade female students from a Saudi school. 37 students were randomly assigned to two groups. Nineteen students represented the experimental group and eighteen students represented the control group.

3.8. Research Instruments

The researchers designed a practical programming skills test in HTML, an academic motivation scale and a teacher's intervention guide for this study.

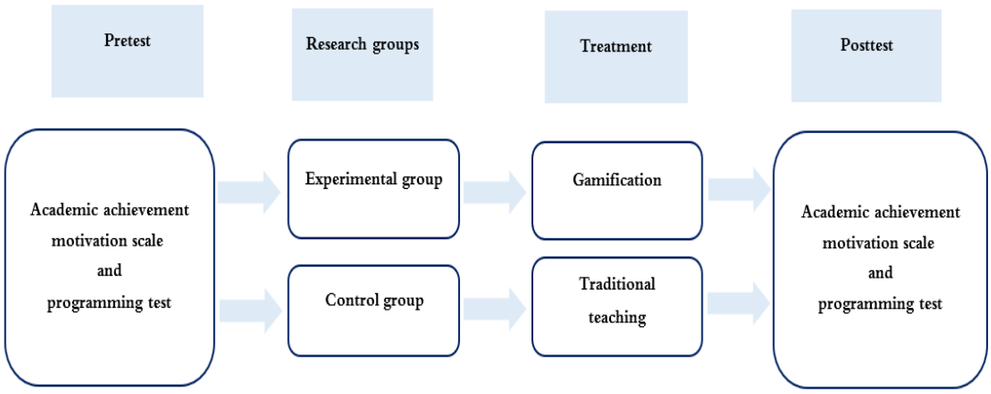

Figure 2. The study designs.

3.9. The HTML Programming Skills Test

The test was applied in the computer laboratory before and after the treatment to reveal the impact of gamification on developing programming skills among 10th-grade students. The skill objectives included in the HTML unit were identified and the test was reviewed by computer supervisors, teachers and faculty members to properly prepare for the practical test. The test consisted of 18 questions targeting primary skills in HTML including the main tags in HTML, paragraphs, lists, multimedia and hyperlinks. In order to ensure validity, reliability, clarity of instructions and sufficient time to complete the test, a pilot study was conducted on 11th-grade students who had already finished the HTML unit. The test's reliability coefficient was calculated using the split-half method. The test questions were divided into two halves. The Pearson correlation coefficient was calculated between the first half of the test and the second half and it was 0.622. Since the first question was confusing, the researchers removed it and the test's reliability coefficient was recalculated using the Spearman-Brown formula. Consequently, the test's reliability coefficient has increased to 0.768, a high and acceptable coefficient.

3.10. The Academic Achievement Motivation Scale

The researcher reviewed the related literature to determine the items and dimensions of the scale to establish the academic achievement scale. The researchers created scale items (39 items) relying on studies including Hermans (1970); Khalifa (2006); Alsalami (2019); Zakry (2021) and Alsalami (2019). Based on the reviewers' feedback, the scale has six dimensions including desire to excel and succeed (7 items), academic persistence (7 items), academic achievement behavior (7 items), goal orientation (6 items), academic competition (6 items) and enjoyment (6 items). The student's academic achievement motivation was measured using a four-point Likert scale (strongly agree, agree, disagree, strongly disagree).

To ensure construct validity and face validity, the scale was reviewed by more than ten experts in the field of education. Furthermore, a pilot study was conducted for the scale on (59) 11th-grade students in a Saudi school to ensure the clarity of the scale items and determine the sufficient time to complete the scale which is 14 minutes. Based on students' feedback, item number 25 was paraphrased. Cronbach's alpha was calculated for scale reliability, and the internal consistency coefficient is above 0.68 on all scale dimensions. Table 1 shows the coefficient values for the dimension.

3.11. The Intervention

The researchers designed a teacher's guide about how to teach the HTML unit through gamification. The primary purpose of the teacher's guide is to assist the teacher with adopting gamification properly. So, the researcher redesigned the HTML unit in the digital skills textbook for 10th-grade students based on gamification principles such as points and levels to develop students' programming skills and academic achievement motivation. Computer teachers and specialists in education reviewed the teacher's guide particularly in instructional design and computer curriculum and instruction to ensure the validity of this guide.

Table 1. The reliability of the academic achievement motivation scale.

Dimensions of academic achievement motivation	Cronbach's alpha
Desire to excel and succeed	0.742
Goal orientation	0.772
Academic persistence	0.796
Academic competition	0.677
Academic achievement behavior	0.708
Enjoy programming	0.809
Total	0.933

3.12. The Pre-Test Results of the Experimental and Control Groups

The researchers applied the programming test and the academic achievement motivation scale before the treatment to both groups (the experimental and the control groups) to verify the equivalence before starting the experiment. A Mann-Whitney (U) test was run to identify if there were any differences between the experimental and control groups in either programming skills or academic achievement motivation. The results showed that there are no statistical differences between the two groups in terms of programming skills or academic achievement. So, the two groups are equivalent as reported in Tables 2 and 3.

Table 2. The equivalence of the experimental and control groups in HTML programming skills before the treatment.

Programming skills	Groups	N	Mean rank	Sum of ranks	Mann-Whitney U	Z	Sig.
Programming skills	Experimental group	19	19.68	374.00	158.00	0.432	0.67
	Control group	18	18.28	329.00			

Table 3. The equivalence of the experimental and control groups in the academic achievement motivation scale before the treatment.

Academic achievement motivation	Groups	N	Mean rank	Sum of ranks	Mann-Whitney U	Z	Sig.
Total	Experimental group	19	21.97	417.50	114.50	1.719	1.72
	Control group	18	15.86	285.50			

3.13. The Treatment

After ensuring the equivalence of the two groups, the researchers prepared the computer lab and ensured the provision of smart devices and the internet. The experimental group was taught using gamification while the control group was taught traditionally. The research experiment lasted three weeks (9 classes) with three classes per week for each group. After completing the teaching of the HTML unit in both groups, the researchers reapplied the programming skills test and academic achievement motivation in both groups. Figure 3 shows the study intervention.

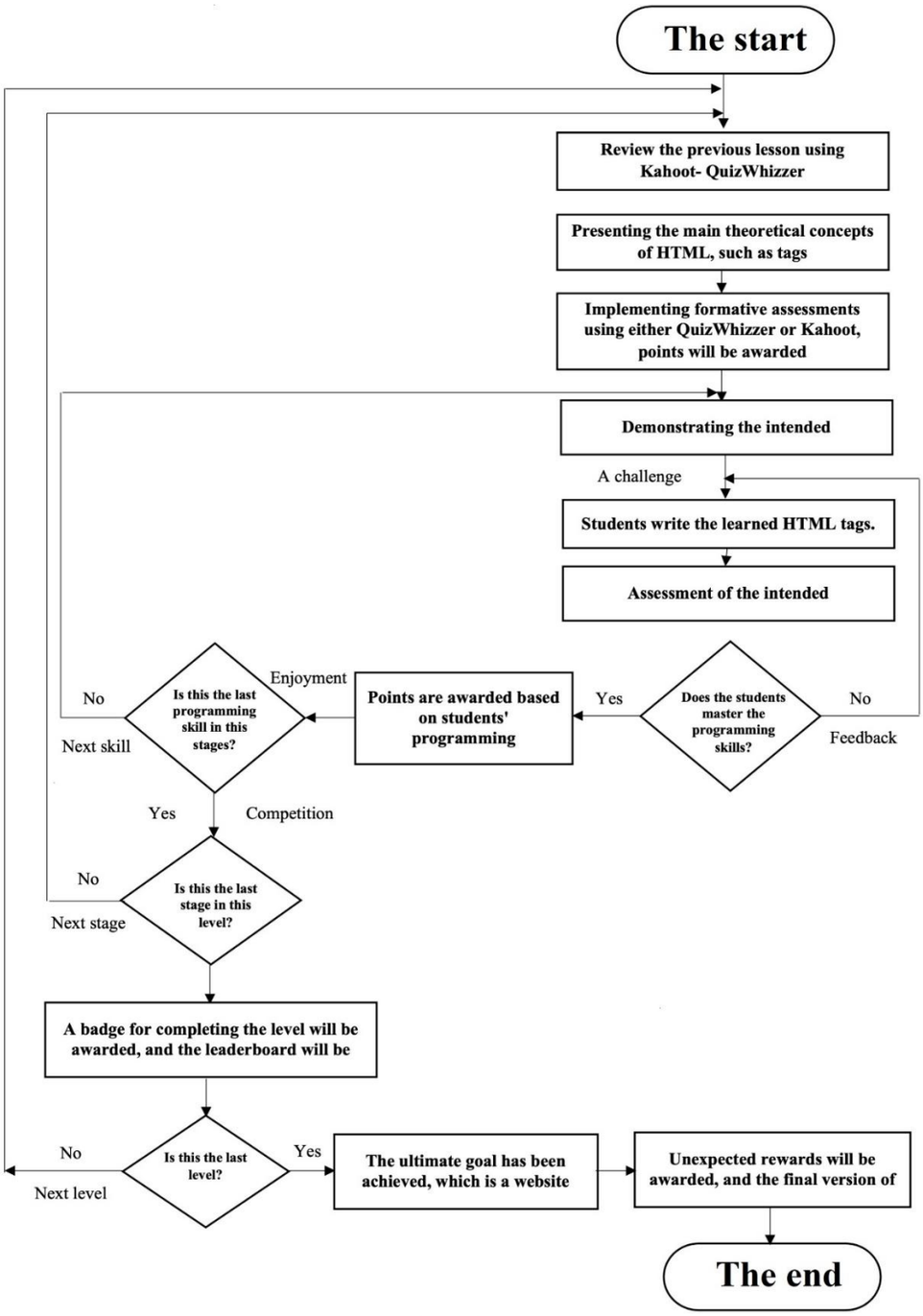

Figure 3. The study intervention.

3.14. The Result and Discussion of the First Research Question

To answer the first research question, "to what extent does adopting gamification affect developing HTML programming skills for 10th-grade students in the digital technology course?" The students in both groups were asked to take the HTML programming skills exam after completing the HTML unit. Using the Mann-Whitney U

test, the result reveals statistical differences between the gamification and control groups in all the targeted programming skills in favor of the gamification group. Table 4 shows the differences between the groups. Thus, the null hypothesis is rejected. This study's results are consistent with other studies that have demonstrated gamification efficacy in acquiring visual basic programming skills for students (Abdullah, 2021; Altabbakh & Ismail, 2019; Salem, 2022). Moreover, the gamification strategy is beneficial in teaching Java programming skills (Khaleel, Ashaari, & Wook, 2020), teaching PHP ("PHP: Hypertext Preprocessor") (Ouahbi, Darhmaoui, & Kaddari, 2021) and teaching HTML (Saad, Arafa, Balat, & Hawa, 2022). Abduljalil, Abdullah, Al-Batroui, and Mabad (2021) concluded that gamification is vital in improving students' programming skills and concepts using Scratch software. Furthermore, Elsherbiny and Saleh (2021) found that gamification enhanced students' programming skills in the context of programming robots.

Sailer and Homner (2020) indicated that gamification as an educational approach influences cognitive, motivational and behavioral learning outcomes. Moreover, Rodrigues et al. (2021) stated that students learned programming by influencing their motivations through gamification which affected learning outcomes. Therefore, gamification indirectly affects learning through motivation. Moreover, Pinto and Terroso (2022) mentioned that gamification and problem-based learning motivated students to be more engaged in the educational process and learning to program. It also made learning programming more attractive and enjoyable.

Table 4. Comparing the programming skills of the control and the gamification groups after the treatment.

Programming skills	Groups	N	Mean rank	Sum of ranks	Mann-Whitney U	Z	Sig.
Using visual studio code	Experimental group	19	23.00	437.00	95.00	3.21	0.001
	Control group	18	14.78	266.00			
Paragraphs, lists and multimedia	Experimental group	19	26.42	502.00	30.00	4.48	0.000
	Control group	18	11.17	201.00			
Hyperlinks	Experimental group	19	25.76	489.50	42.50	4.03	0.000
	Control group	18	11.86	213.50			
Programming skills	Experimental group	19	26.92	511.50	20.50	4.68	0.000
	Control group	18	10.64	191.50			

The superiority of the experimental group students could be attributed to the fact that gamification made programming learning enjoyable mixed with a cooperative and competitive atmosphere through individual and group activities designed for that purpose. Gamification meets the psychological characteristics of 10th-grade students as students at this stage tend to be independent, competitive, challenging and enjoy learning (Zichermann & Cunningham, 2011). According to Zainuddin, Chu, Shujahat, and Perera (2020), gamification uses game elements to stimulate internal and external motivation such as the leaderboard element which motivates the learners externally while challenges motivate them internally. It provides opportunities for freedom. Gamification activities are different from traditional activities in that they require students to repeat their attempts when facing the challenges of HTML programming (Alsawaier, 2018).

It was noticeable that providing immediate feedback using gamification elements (points, badges and leaderboards) raised students' performance and desire to learn. When students master a skill, they obtain points and move on to the next stage. At the end of the stage, they will get a badge, rewards will be given, their names will be on the leaderboards and they will move up to the next level. Thus, the levels of gamification contributed to raising the learners' motivation to complete as many levels as possible to rank up in the leaderboard and obtain as many badges as possible (Ramzi, 2019).

In addition to the entertaining environment created by gamification when learning to program, the division of programming skills into gradual difficulty levels contributed to facilitating the acquisition of programming skills by organizing those skills and linking previous programming experience with the following skills which is one of the essential principles of constructivist theory (Alomari & Alshanqeeti, 2019).

The researchers also noticed that gamification allowed students to design their avatars and profiles Class Dojo which reinforced their psychological needs such as competence, independence and self-control and increased the student's achievement of assignments and programming activities (Alsadoon, Alkhawajah, & Suhaim, 2022; Sailer, Hense, Mandl, & Klevers, 2013).

4. The Result and Discussion of the Second Research Question

To answer the second research question, "To what extent does adopting gamification in a classroom affect 10th-grade students' academic achievement and motivation in the digital technology course?" Students in both groups were asked to fill out the academic achievement motivation scale after completing the HTML unit. Using the Mann-Whitney U test, the result reveals statistical differences between the gamification and control groups in all the scale dimensions in favor of the gamification group. Table 5 shows the differences between the groups. Thus, the null hypothesis is rejected.

This result supports previous studies' findings that demonstrated gamification's effectiveness in developing academic achievement motivation for programming skills (Elsherbiny & Saleh, 2021; Ramzi, 2019). This result can be explained by analyzing the relationship between the gamification mechanism used in the study and academic achievement motivation dimensions. At the beginning of the experiment, the instructor explained the gamification procedures and clarified the programming skills that were divided into levels and stages which were also explained in the worksheets distributed to the experimental group's students. Also, the reward and incentive schedules were presented. Furthermore, at the beginning of each class, the programming skills that must be mastered to move to the next stage were introduced as well as the number of points that will be gained when performing the skills successfully which stimulated one of the academic achievement motivation dimensions which is " goal orientation." Sailer et al. (2013) state that the progress bars provide the learners with information about their position concerning the ultimate goal and compare their current performance with the previous one, making them focus on constantly improving and reinforcing their orientation towards goals.

Table 5. Comparing the control group and the gamification group in academic achievement motivation after the treatment.

Academic achievement motivation dimension	Groups	N	Mean rank	Sum of ranks	Mann-Whitney U	Z	Sig.
Desire to excel and succeed	Experimental group	19	26.63	506.00	26.00	4.44	0.000
	Control group	18	10.94	197.00			
Oriented toward a goal	Experimental group	19	27.24	517.50	14.50	4.81	0.000
	Control group	18	10.94	185.50			
Academic persistence	Experimental group	19	27.16	516.00	16.00	4.77	0.000
	Control group	18	10.39	187.00			
Academic competition	Experimental group	19	25.53	485.00	47.00	3.80	0.000
	Control group	18	12.11	218.00			
behavior of academic achievement	Experimental group	19	26.97	512.50	19.50	4.64	0.000
	Control group	18	10.58	190.50			
Enjoy programming	Experimental group	19	26.79	509.00	23.00	4.56	0.000
	Control group	18	10.78	194.00			
Total	Experimental group	19	26.79	509.00	6.500	5.00	0.000
	Control group	18	10.78	194.00			

Furthermore, when providing immediate feedback to the students and awarding points upon mastering the skill and badges after completing the level, the student's "desire to excel and success" is activated. Upon completion of the level, the leaderboard is displayed and the students who have obtained the highest number of points which raises the student's "academic competition." According to Sailer et al. (2013), leaderboards enhance competition and a sense of competence for learners at the top of the ranking enhancing affiliation and social connection among group members if used at the group level.

Points motivate students to exert more effort to carry out the required programming tasks, despite the challenges or difficulties they may face which enhances their academic perseverance (Zainuddin et al., 2020). Additional points were allocated to the persevering student who performed additional programming skills that were not required or performed the following lesson programming skills in advance, raising the students' academic perseverance and desire to excel and succeed.

Furthermore, the required home tasks have been restricted to a specific time. When the student is late in delivering the task, points are deducted from the student which motivates the student to submit the task on time and thus activates the "academic achievement behavior." Moreover, with the use of points, badges, challenges, avatars and programs such as (Kahoot and Quiz Whizzer), the classroom turned into a game and made learning to program and design websites in (HTML) enjoyable. According to Oxford Analytica (2016), badges constitute mediating goals since they are given upon completing sub-tasks. Therefore, the learner's desire to obtain as many badges as he or she can to complete all the sub-tasks. The learner's focus is not limited to the current task only which may lead him or her to boredom or to the ultimate goal of the game which may be far or difficult to achieve but rather the desire to win various additional badges that would improve the learner's engagement in the learning in an attractive manner and target " academic achievement behavior (Mubin et al., 2020; Ortiz-Rojas, Chiluiza, & Valcke, 2017).

5. Conclusion and Limitations

This study aimed to identify the impact of adopting gamification in teaching for developing 10th-grade students' HTML programming skills and investigate whether gamification influences student academic achievement motivation. The result revealed that gamification positively affected students' programming skills and academic achievement in the experimental group. So, this study recommends providing adequate professional development for teachers to help them adopt it properly since designing the gamification environment is challenging. If the teacher does not carefully prepare the environment, this might adversely affect students' academic achievement. The success of adopting gamification does not only depend on using its elements, it extends to having a mechanism to design and employ its elements to be carefully connected to meet intended learning outcomes and enhance the student's internal and external motivations. There is competition, challenge, rewards, feedback and badges which make gamification purposeful, beneficial and enjoyable. The ministry of education may create a guidebook on how to employ gamification in teaching and shed light on its importance in many educational situations. Furthermore, establishing a community of practice and sharing the distinguished teaching practices that creatively adopted gamification among teachers would play a vital role in increasing the adoption of this strategy.

This study has some limitations. This study targeted developing HTML programming skills in 10th grade female students. Future research might study other computer programming languages such as Java and Python, look at the influence of gamification on male students and check for differences based on students' gender or grade level. This experiment lasted three weeks (nine classes). Future studies may consider extending the experiment period so that students can learn these teaching techniques and thus gain the maximum benefit from this teaching strategy.

References

Abduljalil, Z. M., Abdullah, I. A., Al-Batroui, A. A., & Mabad, M. S. (2021). The effectiveness of designing an electronic learning environment based on gamification in developing programming skills for preparatory stage student. *Journal of Educational and Social Studies*, *27*(3), 57-96.

Abdullah, M. H. (2021). The effectiveness of micro-teaching based on game stimuli in developing programming skills among deaf university students. *International Journal of E-Learning*, *3*(3), 637-729.

Alabbadi, A. A., & Qureshi, R. J. (2016). The proposed methods to improve teaching of software engineering. *International Journal of Modern Education and Computer Science*, *8*(7), 13-21. https://doi.org/10.5815/ijmecs.2016.07.02

Alastal, M. Z., Akl, M. S., & Al-Agha, M. (2021). Developing a proposed model based on artificial intelligence and its effectiveness in developing programming skills among students of the University College of Science and Technology in Khan Yunis. *Journal of the Islamic University for Educational and Psychological Studies*, *29*(1), 743-772.

Alomari, A. B., & Alshanqeeti, O. M. (2019). The effectiveness of gamification technology in the electronic learning environment to develop the producing digital materials skills and creative thinking for postgraduate students. *IUG Journal of Educational and Psychology Science, 27*(2), 661-629.

Alqarni, S. A., & Imran, A. M. (2021). The impact of artificial intelligence (Microbit) on raising female students' motivation towards learning programming in the educational technologies course at King Abdulaziz University in Jeddah. *Journal of Educational and Psychological Sciences, 5*(30), 58-76.

Alrabighi, K. M. (2015). *Achievement motivation. In habits of mind.* Jourdan: De Bono Center For Teaching Thinking.

Alsadoon, E., Alkhawajah, A., & Suhaim, A. B. (2022). Effects of a gamified learning environment on students' achievement, motivations, and satisfaction. *Heliyon, 8*(8), e10249. https://doi.org/10.1016/j.heliyon.2022.e10249

Alsaeed, N. R. (2020). The interaction between content delivery style and cognitive styles in a digital learning environment to develop educational website production skills among postgraduate students. *Journal of Digital Learning and Teaching Technology, 1*(1), 90-120.

Alsalami, S. (2019). *The effectiveness of an educational environment based on digital gamification in developing computer skills and achievement motivation among first-grade intermediate students.* Dissertation.

Alsawaier, R. S. (2018). The effect of gamification on motivation and engagement. *The International Journal of Information and Learning Technology, 35*(1), 56-79. https://doi.org/10.1108/ijilt-02-2017-0009

Altabbakh, H. A., & Ismail, A. T. (2019). Interaction between gamification model (adaptive/collaborative) and feedback type (instant/deferred) and its effect on programming and engagement skills for educational technology students. *Arab Studies in Education and Psychology, 1*(108), 60-132.

Ardiana, D. P. Y., & Loekito, L. H. (2020). Gamification design to improve student motivation on learning object-oriented programming. *Journal of Physics: Conference Series, 1516*(1), 12-41. https://doi.org/10.1088/1742-6596/1516/1/012041

Barneva, R. P., Kanev, K., Kapralos, B., Jenkin, M., & Brimkov, B. (2017). Integrating technology-enhanced collaborative surfaces and gamification for the next generation classroom. *Journal of Educational Technology Systems, 45*(3), 309-325. https://doi.org/10.1177/0047239516671945

Biju, S. M. (2018). Best approach to teach advanced programming. *International Journal of Education and Management Engineering, 8*(6), 37-45.

Butler, M., & Morgan, M. (2007). *Learning challenges faced by novice programming students studying high level and low feedback concepts.* Paper presented at the Proceedings Ascilite Singapore.

Chapman, J. R., & Rich, P. J. (2018). Does educational gamification improve students' motivation? If so, which game elements work best? *Journal of Education for Business, 93*(7), 315-322. https://doi.org/10.1080/08832323.2018.1490687

Christy, K. R., & Fox, J. (2014). Leaderboards in a virtual classroom: A test of stereotype threat and social comparison explanations for women's math performance. *Computers & Education, 78*, 66-77. https://doi.org/10.1016/j.compedu.2014.05.005

Cuervo-Cely, K. D., Restrepo-Calle, F., & Ramírez-Echeverry, J. J. (2022). Effect of gamification on the motivation of computer programming students. *Journal of Information Technology Education: Research, 21*, 001-023. https://doi.org/10.28945/4917

Deci, E. L., & Ryan, R. M. (2000). The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*(4), 227-268. https://doi.org/10.1207/s15327965pli1104_01

Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). *From game design elements to gamefulness: Defining" gamification.* Paper presented at the Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments.

Dwijuliani, R., Rijanto, T., Nurlaela, L., & Basuki, I. (2021). *Increasing student achievement motivation during online learning activities.* Paper presented at the Journal of Physics: Conference Series.

Elsherbiny, Z. H., & Saleh, M. A. (2021). The effect of different presentation patterns of electronic game stimuli) (badges and leaderboards) based on learning analytics to develop educational robot programming skills and achievement motivation among students of the STEM program at the College of Education. *International Journal of E-Learning, 4*(3), 607-708.

Elshiekh, R., & Butgerit, L. (2017). Using gamification to teach students programming concepts. *Open Access Library Journal, 4*(8), 1-7. https://doi.org/10.4236/oalib.1103803

Fischer, S., & Barabasch, A. (2020). Gamification: A novel didactical approach for 21st century learning. In Eveline Wuttke, Jürgen Seifried & Helmut Niegemann (Eds.), Vocational education and training in the age of digitization. In (pp. 89-106). Opladen: Verlag Barbara Budrich.

Hamari, J., Koivisto, J., & Sarsa, H. (2014). *Does gamification work?--a literature review of empirical studies on gamification.* Paper presented at the 2014 47th Hawaii International Conference on System Sciences. Ieee.

Heckhausen, H. (1968). *Achievement motive research: Current problems and some contributions towards a general theory of motivation. In W. J. Arnold (Ed.), Nebraska Symposium on Motivation* (Vol. 16). Lincoln: University of Nebraska Press.

Hermans, H. J. (1970). A questionnaire measure of achievement motivation. *Journal of Applied Psychology, 54*(4), 353-363. https://doi.org/10.1037/h0029675

Ismail, M. N., Ngah, N. A., & Umar, I. N. (2010). Instructional strategy in the teaching of computer programming: A need assessment analyses. *The Turkish Online Journal of Educational Technology, 9*(2), 125-131.

Jenkins, T. (2001). The motivation of students of programming. *SIGCSE Bulletin, 33*(3), 53-56.

Kapp, K. M. (2012). *The gamification of learning and instruction: game-based methods and strategies for training and education.* San Francisco, CA: John Wiley & Sons.

Kert, S. B., & Erkoç, M. F. (2017). Game-Based approaches, gamification, and programming language training. In *Gamification-based e-learning strategies for computer programming education* (pp. 131-151). Hershey, PA: IGI Global.

Khaleel, F. L., Ashaari, N. S., & Wook, T. S. M. T. (2019). An empirical study on gamification for learning programming language website. *Technology Journal, 81*(2), 1-12.

Khaleel, F. L., Ashaari, N. S., & Wook, T. S. M. T. (2020). The impact of gamification on students learning engagement. *International Journal of Electrical and Computer Engineering, 10*(5), 4965-4972.

Khalifa, A. M. (2006). *Achievement motivation scale* (1st ed.). Cairo, Egypt: Dar Alghareeb.

Kim, S., Song, K., Lockee, B., & Burton, J. (2018). *Gamification in learning and education: Enjoy learning like gaming.* Switzerland: Springer International Publishing AG.

Llorens-Largo, F., Gallego-Durán, F. J., Villagrá-Arnedo, C. J., Compañ-Rosique, P., Satorre-Cuerda, R., & Molina-Carmona, R. (2016). Gamification of the learning process: Lessons learned. *IEEE Ibero-American Journal of Learning Technologies, 11*(4), 227-234. https://doi.org/10.1109/rita.2016.2619138

Ly, P., Degeng, I. N. S., Setyosari, P., & Sulton, S. (2016). *Relationship between achievement motivation and learning outcomes on land law course vy student of PPKN Nusa Cendana University.* Paper presented at the International Conference on Education (ICE2) 2018: Education and Innovation in Science in the Digital Era.

Mahato, A., & Barman, P. (2019). Academic achievement motivation and academic performance of SC, ST community students in the District of Purulia. *American Journal of Educational Research, 7*(11), 872-877.

Majuri, J., Koivisto, J., & Hamari, J. (2018). *Gamification of education and learning: A review of empirical literature.* Paper presented at the Proceedings of the 2nd International GamiFIN Conference, GamiFIN 2018. CEUR-WS.

Mamin, R., Hasanuddinlv, H., & Samputri, S. (2020). *The influence of achievement motivation towards student learning outcomes on department of natural science education of Makassar State University.* Paper presented at the International Conference on Science and Advanced Technology (ICSAT).

Martens, A., & Muller, W. (2017). Gamification. In Nakatsu, R., Rauterberg, M., & Ciancarini, P. (Eds.), Handbook of digital games and entertainment technologies. In (pp. 901-931). Singapore: Springer.

Maryono, D., Budiyono, S., & Akhyar, M. (2022). Implementation of gamification in programming learning: Literature review. *International Journal of Information and Education Technology, 12*(12), 1448-1457.

McClelland, C. D. (2000). *Human motivation.* New York: Cambridge University Press.

Mohorovicic, S., & Strcic, V. (2011). *An overview of computer programming teaching methods.* Paper presented at the Central European Conference on Information and Intelligent Systems. Faculty of Organization and Informatics Varazdin.

Mubin, S. A., Poh, M. W. A., & Jantan, A. H. (2020). Gamification in programming language learning: A review and pathway. *International Journal of Advanced Research in Engineering and Technology, 11*(12), 1148-1155.
Muntean, C. I. (2011). *Raising engagement in e-learning through gamification*. Paper presented at the Proceeding. 6th International Conference on Virtual Learning ICVL.
Ortiz-Rojas, M., Chiluiza, K., & Valcke, M. (2017). *Gamification in computer programming: Effects on learning, engagement, self-efficacy and intrinsic motivation*. Paper presented at the European Conference on Games Based Learning.
Ouahbi, I., Darhmaoui, H., & Kaddari, F. (2021). Gamification approach in teaching web programming courses in PHP: Use of KAHOOT application. *International Journal of Modern Education & Computer Science, 13*(2), 33-39.
Oxford Analytica. (2016). *Gamification and the future of education*. Retrieved from https://www.worldgovernmentsummit.org/docs/default-source/publication/2016/gamification/gamification_en.pdf?sfvrsn=b710f0a_2
Pinto, M., & Terroso, T. (2022). *Learning computer programming: A gamified approach*. Paper presented at the Third International Computer Programming Education Conference (ICPEC 2022). Schloss Dagstuhl Leibniz Center for Computer Science.
Psycharis, S., & Kallia, M. (2017). The effects of computer programming on high school students' reasoning skills and mathematical self-efficacy and problem solving. *Instructional Science, 45*(5), 583-602.
Queirós, R. (2019). A gamification framework based on programming exercises usage data. *Information, 10*(2), 1-14.
Ramzi, H. S. (2019). The relationship between the two elements of the digital game strategy "Leaderboard / badge list" in an e-learning environment and its impact on developing programming skills and achievement motivation among educational technology students in specific education colleges. *Scientific Journal of Educational and Arabic Studies and Research, 10*(1), 141-190.
Riar, M., Morschheuser, B., Zarnekow, R., & Hamari, J. (2022). Gamification of cooperation: A framework, literature review and future research agenda. *International Journal of Information Management, 67*, 102549. https://doi.org/10.1016/j.ijinfomgt.2022.102549
Rodrigues, L., Toda, A. M., Oliveira, W., Palomino, P. T., Avila-Santos, A. P., & Isotani, S. (2021). *Gamification works, but how and to whom? An experimental study in the context of programming lessons*. Paper presented at the Proceedings of the 52nd ACM Technical Symposium on Computer Science Education.
Saad, A. M., Arafa, R. K., Balat, H. F., & Hawa, D. M. (2022). The effect of gamification within the e-learning environment on the development of programming skills for university education students. *Journal of Positive School Psychology, 6*(7), 4939-4952.
Sailer, M., Hense, J., Mandl, H., & Klevers, M. (2013). Psychological perspectives on motivation through gamification. *Interaction Design and Architecture Journal, 19*(1), 28-37.
Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior, 100*(69), 371-380.
Sailer, M., & Homner, L. (2020). The gamification of learning: A meta-analysis. *Educational Psychology Review, 32*(1), 77-112.
Salem, M. A. (2022). A three-dimensional learning environment based on digital game stimuli (stories/points) to develop some programming skills among educational technology students and their involvement in the learning environment. *Refereed Scientific Journal of the Egyptian Society for Educational Computer, 10*(1), 431-540.
Sarpong, K. A.-M., Arthur, J. K., & Amoako, P. Y. O. (2013). Causes of failure of students in computer programming courses: The teacher-learner perspective. *International Journal of Computer Applications, 77*(12), 1-6.
Schöbel, S., Janson, A., Jahn, K., Kordyaka, B., Turetken, O., Djafarova, N., . . . Adam, M. (2020). A research agenda for the why, what, and how of gamification designs: Outcomes of an ECIS 2019 panel. *Communications of the Association for Information Systems, 46*(1), 706-721.
Scott, L., & Dalton, N. (2021). *Studying the impact of gamification on motivation in remote programming education*. Paper presented at the Academic Conferences International Limited"European Conference on e-Learning", Kidmore End, United Kingdom.
Sikhwari, T. (2014). A study of the relationship between motivation, self-concept and academic achievement of students at a university in Limpopo Province, South Africa. *International Journal of Educational Sciences, 6*(1), 19-25.
Steinmayr, R., Weidinger, A. F., Schwinger, M., & Spinath, B. (2019). The importance of students' motivation for their academic achievement–replicating and extending previous findings. *Frontiers in Psychology, 10*(1730), 1-11.
Tolba, E. G. (2021). *Spiritual intelligence and science teaching: One's journey to transcendence*. Dammam, Saudi Arabia: Almutanabi Library.
Topalli, D., & Cagiltay, N. E. (2018). Improving programming skills in engineering education through problem-based game projects with Scratch. *Computers & Education, 120*, 64-74. https://doi.org/10.1016/j.compedu.2018.01.011
Tsai, C.-Y., & Lai, Y.-C. (2022). Design and validation of an augmented reality teaching system for primary logic programming education. *Sensors, 22*(1), 1-17.
Vision 2030 Kingdom of Saudi Arabia. (2016). *Saudi national transformation program delivery plan 2021 – 2025*. Retrieved from https://www.vision2030.gov.sa/media/nhyo0lix/ntp_eng_opt.pdf
Wiyono, B. B., & Wu, H. H. (2022). Investigating the structural effect of achievement motivation and achievement on leadership and entrepreneurial spirit of students in higher education. *Administrative Sciences, 12*(3), 1-17.
Xia, B. S., & Liitiäinen, E. (2017). Student performance in computing education: An empirical analysis of online learning in programming education environments. *European Journal of Engineering Education, 42*(6), 1025-1037.
Yildirim, I. (2017). The effects of gamification-based teaching practices on student achievement and students' attitudes toward lessons. *The Internet and Higher Education, 33*(1), 86-92.
Zainuddin, Z., Chu, S. K. W., Shujahat, M., & Perera, C. J. (2020). The impact of gamification on learning and instruction: A systematic review of empirical evidence. *Educational Research Review, 30*, 100326. https://doi.org/10.1016/j.edurev.2020.100326
Zakry, A. M. A. (2021). The attitude towards the psychological measurement course and its relationship to test anxiety and achievement motivation among family counseling diploma program students at Majmaah University. *Journal of Education - Sohag University, 3*(92), 1456-1517.
Zambuk, U. B. (2021). Achievement motivation and academic self-efficacy as correlates of academic performance among senior secondary school students in Bauchi State. *International Journal of Advances in Engineering and Management, 3*(9), 1512-1519.
Zhan, Z., He, L., Tong, Y., Liang, X., Guo, S., & Lan, X. (2022). The effectiveness of gamification in programming education: Evidence from a meta-analysis. *Computers and Education: Artificial Intelligence, 3*, 100096. https://doi.org/10.1016/j.caeai.2022.100096
Zichermann, G., & Cunningham, C. (2011). *Gamification by design: Implementing game mechanics in web and mobile apps*. Sebastopol, CA: O'Reilly Media.
Zichermann, G., & Linder, J. (2013). *Gamification revolution*. Columbus, USA: MC Graw Hill Education.