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An Empirical Study Gender-Based Perception of Gamification and its Impact on Programming Skill Enhancement

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Abstract

Over the past decade, the utilization of gamification in education has become increasingly prevalent as a means of enhancing students' learning experiences. Despite its growing popularity, educators still harbor concerns about the acceptance of gamification techniques among students. However, game-based activities have been shown to improve both student learning and attitudes in undergraduate engineering courses, regardless of the evaluation method employed. As a potential technique for increasing student participation and improving learning outcomes, utilization of gamification has been recognized as a valuable strategy.

The current study focuses on measuring gender-based student perceptions regarding the adoption of gamification and its impact on learning programming skills. The results indicate that there is a notable gender gap in the perception and acceptance of gamification, emphasizing the need to take gender into account when implementing gamification in courses. Furthermore, the study highlights that gamification can effectively enhance the programming skills of engineering students.

Keywords: Gamification, gamify, education, education technology, perception, programming skills, coding, engineering education

Introduction

One of the most emerging and frequently used instructional technologies in education this decade has been gamification, in particular. The educational needs of the new generation of students can be met by gamification. The implementation of game design elements in situations other than games is known as gamification. In other words, the goal of gamification is to create or modify experiences in order to convey similar emotions and engagement to those experienced

while playing games, however not for amusement. The hazards associated with gamification have also been noted, but scientific research into it is still in its infancy. Due to improperly gamified business processes, 80% of gamified applications, according to Gartner, will fall short of meeting business objectives. Today, engineering education and being able to do programming is a top priority specifically when we consider the skills for Industry 5.0 (Mitchell & Guile, 2021). The potential of gamification in education is founded on the idea that it helps and inspires students, which can improve learning outcomes and procedures. However, this procedure is not simple, and it takes educators a lot of time and effort. In addition, the methods employed to gamify educational activities are not consistently understood. The failure of various educational gamification efforts due to this lack of consistency has had unintended and unforeseen repercussions on the learning process and learning outcomes. At the same time, very few studies have addressed gender-based gamification and game elements for creating the learning process among learners.

Gamification in education is the practice of incorporating game design features and game-like experiences into the development of instructional materials. Since 2013, gamification in higher education has drawn attention and expanded quickly.

Programming courses are an essential requirement to complete engineering education. Emphasis on teaching programming, algorithms, and logic in all disciplines of engineering has increased over the years due to the advancement of the application of machine learning and artificial intelligence (Ouahbi et al., 2021). However, there have been large withdrawals from the introductory programming courses as compared to other courses as students find it difficult to learn, given that it includes a lot of new, complex, and abstract topics in programming. (Marín et al., 2018, Swacha, Queirós, & Paiva, 2019). Programming courses pose several difficulties in designing the curriculum to ensure learners remain motivated to learn programming which calls for innovative pedagogy to teach. Gamification with its proven capabilities to motivate and engage learners could be used to solve the issue of disinterest in learning to program in engineering students. Gamification, has been proven in various educational areas to be capable of rising and retaining the students' engagement (K. M. Kapp, 2012). Designing gamified platforms to optimize desired educational benefits requires careful consideration because gamification is still a relatively new engagement method. When designing a gamified product, it is important to take into account the target audience's demographics, such as gender, age, and

cultural orientation, as these qualities might influence how a user or group responds to gamification (Zahedi et al. 2019).

Objective and Research Questions

The paper aims to present a data-driven gender-wise perception of gamification and its influence on learning programming. Learners are undergraduate students of engineering attending the data structure and mobile app development courses. Kahoot was used to deliver the lectures and formative assessment e-quizzes for the entire semester as a gamification tool for learning.

The following are the research questions framed

RQ1. What is the gender-based perception of engineering students towards gamification?

RQ2. Is there any influence of gamification on learning programming skills?

Literature Review

The concept of gamification has gained significant traction in the education sector over the past decade. According to Deterding et al. (2011), gamification involves the use of game-like features and mechanics to facilitate learning and promote positive behavior change. Pelling (2011) originally defined gamification in 2002 as "applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast." Werbach and Hunter (2012) describe gamification as consisting of three main parts: game elements, game designing techniques, and context. In education, gamification can be used to increase student engagement and motivation towards learning. Examples of gamification in education include using badges or points to reward student progress, incorporating game elements like challenges and quests into lessons, and using interactive simulations and role-playing activities to make learning more engaging. Studies have shown that gamification can have a positive impact on student engagement and motivation, leading to increased learning outcomes and retention (Werbach & Hunter, 2012). However, it's important to note that gamification should be implemented thoughtfully and with consideration for the specific learning objectives and needs of students.

Gamification in higher education

In order to attain the intended learning outcome in technical higher educational contexts, a number of gamification frameworks have been presented in the relevant academic literature. The advocates of gamification have viewed it as a viable replacement for the conventional method of instructing students through the delivery of lectures. They believe it has the potential

to boost the level of engagement shown by students as a result of the incorporation of gaming elements into educational settings. Several research has investigated the ways in which achieving virtual achievements influences the learning process and the level of involvement shown by students.

According to the findings of the studies, virtual achievements such as badges, leaderboards, and points can be useful tools for improving user engagement, which in turn leads to improved performance (Sanchez, Langer, & Kaur, 2020; Pedersen et al., 2017; McDaniel, Lindgren, & Friskics, 2012)

Recent research examined the impact that "escape rooms," a sort of active learning gamified activity, had on the academic achievement of more than one hundred college students enrolled in four distinct science programmes. This exercise's objectives were to refresh the student's memories with the knowledge gained from earlier class activities, as well as to enhance the student's sense of motivation and general well-being. Individuals found that by taking part in this activity, they were able to form a more accurate mental image of the classes they were enrolled in as well as have more favorable feelings towards the classes. (Sánchez-Martn et al., 2020).

One gaming mechanics that looked at was leaderboards and their impact on players' innate drive to win. Six weeks into a C programming course at Waseda University, 35 students were put through a series of tests. Although competitive game components, like as leaderboards, are not advised in learning-focused contexts, they showed that students improved code metrics under gamification conditions even without additional benefits. (Kasahara et al., 2019)

Gamification based 3-day experiment was conducted with 64 students from a large-size Korean institution to examine the impact of rewards, another game feature, on the learning of English vocabulary. As opposed to completion-based incentives, they discovered that performance-based incentives significantly improved learning. (Park et al., 2019)

To test the efficacy of gamification in education a group of 22 first-year Electrical and Electronics engineering students were asked to take part in an interactive workshop. They discovered an upbeat and more cooperative disposition, a delight in assigned activities, and enhanced efficiency in the used questionnaire. The theory that more time spent studying in any setting leads to better results. (Demkah & Bhargava, 2019),

One of the research looked at how three distinct gamification tools impacted students' interest, enthusiasm, focus, perceptions of their own learning, and feelings of accomplishment and pleasure. All three tools (Kahoot, Quizizz, and Google Form) were found to have similar effects on students' perceptions of their learning, but Kahoot! and Quizizz were favoured over Google Form because students were more likely to agree that using those tools would increase their focus, interest, enjoyment, and motivation than using Google Form. (Chaiyo & Nokham, 2017) Players were most engaged by the game's story, challenges, progression, and feedback. The activities were also organised according to the cognitive, performative, and normative facets of schooling. Gamification might be used to surprise and disturb students, encourage active participation in class, and make learning pleasurable. (Langendahl et al., 2016).

Student's lack of interest in studying is related to worse scores in final examinations. The researchers believe the novelty of the method used may have worn off after 16 weeks of investigation. This suggests that any effort to "gamify" the classroom has to be carefully assessed to make sure it doesn't really work against rather than help kids' academic achievement. (Hanus & Fox, 2015)

Using an online wiki-based project was gamified with one game mechanic leaderboard, and the results were analyzed. The results confirmed the hypothesized connection between leaderboards and increased time spent studying, which in turn led to better grades. (Özdener, 2018)

To accomplish the intended learning outcome in educational contexts, numerous gamification frameworks have been developed in the literature. Gamification proponents believe that it is a decent substitute for traditional lecture-based teaching and can assist increase student engagement. Virtual successes' effects on students' learning and engagement have been the subject of numerous research. According to various studies, virtual milestones like badges, leaderboards, and points might help users become more engaged, which in turn enhances performance.

In this regard, the purpose of the current study was to identify how students view the gamification of the educational process of learning programming, as well as whether or not students' perspectives can be unified around a common ground for the notion of gamification.

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Gamification in Programming

Students today must have the flexibility to learn in an ever-changing context dominated by cutting-edge technologies. One must have skills appropriate to succeed in today's job market in the current century. (Dekhane, Xu, & Tsoi,2013). Abilities in programming, in the field of artificial intelligence and data analysis are some of the most in-demand skills today. (Verma, Lamsal, & Verma, 2022). In recent decades, there has been a surge in the amount of research activity that focuses on investigating the challenges associated with the teaching and learning of basic programming. (Hofer, & Groher, 2021).

In the domain of computer education, one of the most difficult challenges to tackle is teaching programming to beginners. Several studies examine the elements that have a detrimental impact on the teaching and learning of programming such as The following aspects are described: the abstract concepts that programming entails, the competencies required for problem resolution, and the mental capacities required for problem decomposition. For many students, this is their first introduction to computational thinking and programming; they must quickly learn the syntax, semantics, and structure of a new non-natural language in short span of time. (Ismail, & Razak, 2021; Teague, 2011; Kinnunen, 2009; Bennedsen, & Caspersen, 2007). As a result, introductory programming courses are frequently marked by a large deal of learning dissatisfaction, a relatively high dropout rate, and a loss of enthusiasm and motivation among students who struggle to learn programming. (Gorman, McKelvey, & Dowling, 2022; Figueiredo, & García-Peñalvo, 2020; Christopher, & Waworuntu, 2021.

The disinterest and demotivation of the students to pursue programming have enabled researchers to explore gamification in context to its application in education, especially in computer programming. Various research has recognized that gamification is a useful strategy that can be utilized to keep students more motivated and interested while they are studying computer programming. (Zainuddin, et al., 2020; Figueiredo, & García-Peñalvo, 2020).

In a similar vein, it was revealed that the passion and programming abilities of students improved when they finished projects that were based on games.

(Sprint & Fox, 2020) carried out a survey both before and after implementing a gamified approach to the instruction of computer programming. They discovered that the utilization of gamification resulted in an increase in the output of the learning process in the learners. Gamification has been shown to contribute to the level of participation that students have in

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programming lessons. (Harrington, & Chaudhry, 2017). (Kumar, & Khurana, 2012) believed that Gamification is a method that can help students of programming learn more and gain full knowledge of the concept without having to spend a significant amount of time reading from the books. The authors were of the opinion that encouraging students to develop their ability to build logic was very important, and that factors such as "environment," "fun," "technology," "pedagogy," and so on play an important role in encouraging students to develop their ability to build logic in order to promote students' engagement and motivation.

Using gamification is one technique to boost motivation, passion, beauty, joy, awe, and success in programming.

Learners Gender

Gender differences are considered to be an important factor in how learners perceive use of technology in learning. (Park et al., 2019; Denden et al., 2021). For instance, research has demonstrated that individuals of older ages have a more difficult time navigating gamified learning settings (Koivisto, & Hamari, 2014). In addition, previous study has shown that the decision-making processes of learners might vary greatly depending on their gender (Venkatesh, & Morris, 2000). Additionally, Venkatesh and Morris claimed that "motivational characteristics have been proposed as a potential basis of gender disparities in gaming." (Venkatesh, & Morris, 2000)

(Lima, & Gouveia, 2020) found that women have a lower level of interest in the fields of computer science, electronics and automation, and digital/video gaming. (Malik et al., 2020) found that in general, female users are more concerned with the ease and enjoyment of using technology, whereas male users are more concerned with the practical applications of technology and also revealed that women are more motivated by the desire to relax and have fun when playing Pok'emon Go, while males are more interested in the game's potential for social interaction and the prospect of achieving goals. Gender inequalities in playing games have already been documented by researchers.

Gender was also found to play a role in how individuals interpreted their own intrinsic and extrinsic drive (Yau, Kan, Cheng, 2011). Specifically, males reported higher levels of both intrinsic and extrinsic motivation toward an artistic endeavor than females. (Conti, Collins, &

Picariello, 2001). Research by (Khan, Ahmad, & Malik, 2017) found that Girls fared better than boys in terms of engagement and learning outcomes when game-based learning was applied. Studies have demonstrated that gender disparities effect how gamification is perceived (Denden et al., 2021; Polo-Peña, Frías-Jamilena, & Fernández- Ruano, 2020; Codish, & Ravid, 2017; Cheong, Filippou, Cheong, 2014)

Additionally, few research have demonstrated that gender differences can have an effect on the academic outcomes of kids. According to the findings of (Matthews, Ponitz, & Morrison, 2009) female students performed significantly better than male students did on a specific learning assignment. In a similar vein, (Carvalho, 2016) discovered that the academic accomplishments of female students were higher than those of male students. This result was explained by the fact that there is a variation in the personality characteristics of the students due to the fact that both genders had similar degrees of intellectual ability. However, there has only been a limited amount of research done on the topic of gender in gamification.

Theoretical Background

Many studies in the field of technology have applied and validated the Technology Acceptance Model (TAM) proposed by Davis in 1989 (Davis, 1989). Studies have shown that TAM is a powerful social-technical model that explains how and why users adopt new technology (Yu, Lin, & Liao, 2017; Lee, & Lehto, 2013). The TAM framework has been verified by other studies, including those by Ha & Stoel (2009) and Nguyen (2015). TAM offers a good platform for researching how well-liked gamification is among users because it is the most prevalent applied model in studies on user adoption of technology, as compared to other models like Theory of Planned Behavior (TPB), due to its simplicity and practicality (Nguyen, 2015).

However, the problem with TAM is that it excludes some crucial factors. This explains why scientists frequently supplement TAM with context- and setting-specific variables (Nguyen, 2015). A good example of this is the incorporation of perceived enjoyment as a prerequisite to user acceptance of IT proposed by Davis, Bagozzi, & Warshaw in 1992 (Davis, Bagozzi, & Warshaw, 1992). Research has found that the likelihood of adopting a certain word processor program is significantly influenced by how enjoyable its use is (Davis, Bagozzi, & Warshaw, 1992). Therefore, to further test the drivers of technology adoption, which include perceived usefulness, perceived ease of use, and perceived enjoyment or playfulness, in the context of

gamification, it is essential to explore the relationship between these drivers and user experience of gamification adoption.

In accordance with the TAM, this study investigates student perceptions of a gamification-based learning system in the context of perceived ease of use, perceived usefulness, and perceived enjoyment or playfulness. This study aims to expand upon the existing literature by investigating the relationship between these drivers and gamification adoption in the education domain.

Research Methodology

To achieve the goal of the study quantitative analysis has been used. Data collection was administered from the engineering colleges in North India where gamification in the class is used for teaching programming.

Cohort consisted of undergraduate students who were chosen from colleges that implemented gamification strategies such as e-quizzes, the Bubble Sort game (teaching of data structure algorithms), and game coding for mobile app development. A structured questionnaire was prepared using google docs and a link of the same was distributed via email to students mentioning the purpose of the research. The study used a proportionate stratified sampling method for presenting an equal number of samples in each stratum (students who were exposed to e-quizzes, the Bubble Sort game (teaching of data structure algorithms), and game coding for mobile app development for learning). Using random sampling forty (40) students from each stratum was chosen. Therefore, the final sample for the study was 120 engineering students.

Gamification was introduced at the beginning of the semester by applying Kahoot! Bubble sort game for teaching data structure algorithms and game coding for mobile app development. Formative assessment was done using Quizizz for e-quizzes.

Students were polled at the end of the semester about their thoughts on gamification and how it affected their programming abilities. Survey findings helped in identifying factors responsible for using gamification and the perception of gamification in learning programming for engineering students.

The perception of students toward gamification was measured using 5-point Likert scale (Joshi et al., 2015), where

1- Indicates Strongly Disagree, 2- Disagree, 3- Neutral, 4- Agree, 5- Strongly Agree.

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Data analysis and findings

The statistical tests for analyzing the data were conducted using Statistical Package for Social Science (SPSS) version 24.0. The study used univariate tests such as independent T- test for comparing the perception of male and female students towards gamifications. The Analysis of variance (ANOVA) was performed to check the difference in factors of gamification adoption using different type of gamification methods. Finally, multiple regression used for evaluating the impact of gamification (perceived ease of use, usefulness, and playfulness) on programming skills of engineering students.

The results are discussed in below sections sub sections

1. Demographic Distribution and factor extraction

44% of female and 56% of Male students participated in the survey.

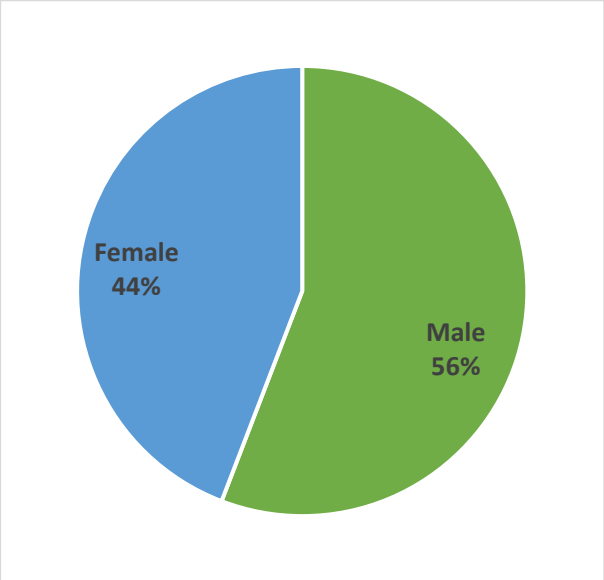

Figure 1- Gender Distribution

Exploratory factor analysis: A factor analysis (EFA) was conducted for extracting the research item into suitable constructs (factors) before performing structural equation modelling. **Adequacy:** The Kaiser–Meyer–Olkin (KMO) value is useful for defining the selected sample size, good enough for further analysis or not. KMO test was 0.789 and Bartlett's Test of Sphericity with approximate chi-square value 1135.38 (statistically significantly at 5% level) indicating data is sufficient for conducting factor analysis.

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Factor Extraction: Fourteen questions are factor analyzed using Principal Component Analysis with Promax rotation. These questions were extracted into four factors explaining a total variance of 77.63 %, with eigenvalues above 1. The factors having loadings above 0.7 are retained for final analysis.

Further, the internal consistency of each factor was calculated by using Cronbach's alpha values, as per Nunnally (1978), the data is reliable when it crosses the threshold value of 0.70. The alpha values given in Table 1, indicates present study data is reliable.

Table 1: Factors loadings and Cronbach's alpha value

	Scale Items	Factor Loadings	Cronbach's alpha
	Perceived ease of use		
PE1	It is easy for me to learn through gamification	.874	0.930
PE2	I find the gamification system to be flexible to be used	.953	
PE3	The online gamification system functionality and interface are clear and understandable	.866	
PE4	Overall, gamification allows interaction effortlessly with the learning system	.889	
	Perceived usefulness		
PU1	I find gamification methods make complex concept to simple that is easy to understand	.908	0.919
PU2	The gamification increased my familiarity with lessons on programming	.887	
PU3	Overall, I feel that gamification is useful in the learning system	.859	
	Perceived playfulness		
PP1	Gamification methods enable me to learn difficult topics while having fun	.875	0.821
PP2	Learning through gamification is an enjoyable process	.829	

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PP3	It is pleasant to use gamification system	.708	
PP4	It is fun to utilize different gamification methods in learning the programming lesson	.729	
	Programming skills Outcomes		
PS1	Gamification system enhance my desire to produce desired result in my learning	.786	0.798
PS2	Gamification improved my learning and programming skills	.818	
PS3	Gamification methods make me more responsible and become more successful in the programming lesson	.796	

2. Descriptive statistics: The mean, standard deviations for all the factor items were presented in below Table 2.

Table 2- Mean and Standard Deviation

Particulars		Perception						
		SDA	DA	N	A	SA	Mean	SD
	Factor 1**: Perceived ease of use**							
PE1		3	24	39	40	14	3.3167	1.004
PE2		3	18	35	50	14	3.4500	0.9688
PE3		6	25	22	59	8	3.7167	1.03699
PE4		3	28	34	46	9	4.0500	.98091
	Factor 2: **Perceived usefulness**							
PU1		1	6	21	75	17	4.2567	.75588
PU2		1	6	31	66	16	4.1250	.78054
PU3		1	5	26	75	13	3.9833	.72394
	Factor 3: **Perceived playfulness**							
PP1		2	3	5	77	33	4.1833	.59385

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PP2		0	1	13	75	31	4.2333	.62083
PP3		0	1	29	67	23	3.9333	.68272
PP4		1	3	16	72	28	4.0250	.73864

Source: Primary survey

Note: Here, SDA-strongly disagree, SA-Strongly agree, N-Neutral

The above Table 2 presents the descriptive statistics of the opinions of the students towards the gamification. It can be noted that the mean responses to the items in the first factor (perceived ease of use) ranges from 3.3 to 4. It indicates that the agreement of the respondents lies between neutral to agree. Similarly, the mean responses towards majority of other two factors (perceived useful & playfulness) ranges from 4 and above, hence it can be observed that overall respondents have opinion from agree to strongly agree with the usefulness and playfulness of gamification system.

3. Perception of male and female students towards gamification

Table 3: Independent Sample Test

Gamification perception	**Gender**	**t-test for Equality of Means**			
		Mean	t	df	Sig. (2-tailed)
Perceived ease of use	Male	3.9876	5.425	118	.000
	Female	3.3287			
Perceived usefulness	Male	4.1029	6.134	118	.000
	Female	3.4149			
Perceived playfulness	Male	4.1960	5.660	118	.000
	Female	3.5496			

The findings of the T-table indicate that both male and female perceived gamifications differently. The Perceived ease of use, T value = 5.425, p=0.000, perceived usefulness T=6.134, p= 0.000 and perceived playfulness T= 5.660, p=0.000. The t values for all these comparison tests are higher than the value 1.96 and p value less than 0.05, confirming the significant

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difference between male and female students towards gamifications. The mean values for all the factors of gamification are higher for male students compared to female students.

4. Analysis of Variance (ANOVA)

The study conducted an ANOVA, perceived ease of use, perceived usefulness and Perceived playfulness were dependent variable and opinion towards gamification as the dependent variable was considered.

Table 4: ANOVA test

		Sum of Squares	df	Mean Square	F	Sig.
Perceived ease of use	Between Groups	1.709	2	.855	1.262	.287
	Within Groups	79.216	117	.677		
	Total	80.925	119			
Perceived usefulness	Between Groups	.239	2	.119	.241	.786
	Within Groups	57.997	117	.496		
	Total	58.236	119			
Perceived playfulness	Between Groups	.716	2	.358	1.263	.287
	Within Groups	33.155	117	.283		
	Total	33.870	119			

From the Table 4 it is found that independent variable is not impacting the gamification. The impact of independent variables: perceived ease of use (F=1.262, p=.287), perceived useful (F=.241, p=.786) and perceived playfulness (F=1.263, p=.287) are statistically insignificant as p values is greater than 0.05. It implies that students those were learning programming through various games such as e-quizzes, game coding etc. having indifferent opinion on perceived ease, use and playfulness of gamification.

5. Impact of gamification on programming skills

The research evaluated the influence of gamification measured through perceived ease of use, perceived usefulness and perceived playfulness on programming skills of engineering students using multiple regression analysis. The study used gamification as predictors and improvement in programming skills as outcome variable.

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Table 5: Correlation between gamification and programming skills outcome:

		PE	PU	PP	PS
PE	Pearson Correlation	1	.654**	.557**	.607**
	Sig. (2-tailed)		.000	.000	.000
	N	120	120	120	120
PU	Pearson Correlation	.654**	1	.639**	.632**
	Sig. (2-tailed)	.000		.000	.000
	N	120	120	120	120
PP	Pearson Correlation	.557**	.639**	1	.602**
	Sig. (2-tailed)	.000	.000		.000
	N	120	120	120	120
PS	Pearson Correlation	.607**	.632**	.602**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	120	120	120	120
**. Correlation is significant at the 0.01 level (2-tailed).					

PE- Perceived ease of use, PU- Perceived usefulness, PP- Perceived playfulness and PS-programming skills

It can be inferred form correlation table that programming skills are positively related with gamification. All the relationships are positive and significant as p value less than 0.05. The positive relation inferred that increase in gamification easiness, usefulness in learning and playfulness also increases programming skills of the students.

Multiple Regression

The result of the ANOVA Table 4 indicates F-test value =39.538 with a significance level of $p<0.05$ ($p=0.000$) indicates the regression model is statistically significant in predicting Programming skills outcomes of students.

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Table 6

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.612	3	9.537	39.538	.000[b]
	Residual	27.981	116	.241		
	Total	56.593	119			
a. Dependent Variable: PS						
b. Predictors: (Constant), Perceived ease of use (PE), usefulness (PU), playfulness (PP)						

Table 7: Coefficients of multiple regression

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.625	.286		2.185	.031
	PE	.256	.083	.272	3.061	.003
	PU	.279	.095	.281	2.935	.004
	PP	.268	.087	.271	3.095	.002
a. Dependent Variable: PS (Programming skills outcome)						

The findings of above table indicate the effect of gamification on programming skills of engineering students. The standardized coefficient (β) values represent the impact of the independent variable on the dependent variable, and here, the perceived usefulness (PU) of gamification system (β=0.281, p=0.004) has the highest impact on programming skills followed by the perceived ease to use (β=0.272, p=0.003) and perceived playfulness (β=0.271, p=0.002). The significance value of $p< 0.05$ proved that all gamification factors have significant impact on improvement in programming skills.

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Table 8: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.711	.506	.493	.49114

The model summary Table 8 indicates that the multiple regression coefficients (R) of gamification factors affecting programming skills outcomes of the engineering students is 0.711 indicating high degree of association between outcome and predictor variables. Further, the coefficient of determination (R square) is 0.506, inferred that 50.6% of the variance in the programming skills significantly explained by the three factors of gamification adoption.

Discussion

The current study evaluates the impact of gamification used in engineering colleges in North India and students' perception towards it. Finally, gamification measured using perceived ease of use, usefulness and playfulness results into enhancement of programming skills in select engineering students.

The comparison between male and female students regarding their perception on gamification system adaptation shows both perceived it differently. The male engineering students have opinion that gamification systems are easy to use, flexible, and useful in learning and they enjoy more while learning programming through gamification compared to female students. The mean perception values for female students are less in comparison with male students.

The findings of the study concluded that gamification leads to improvement in students programming skills. These results are in line with the study of Areed, M. F., Amasha, M. A., Abougalala, R. A., Alkhalaf, S., & Khairy, D. (2021).), that highlighted e-quizzes are better for assessing the learning performance of the students in question. According to the results, students perceived usefulness of gamification in their learning system as most important predictor that enhances their programming skills, knowledge in specific area and familiarity with subjects.

The gamified app provides learners with more opportunities to prepare and learn pre-course materials before going to class, as well as they can better understand the programming in ease and enjoyable environment.

The study suggested that students' perception varies among male and females but it also indicates that both gender prefer gamification for enhancing their programming skills. If students believe that gamification will be beneficial to their education and simple to implement, they are more likely to embrace it. Furthermore, students will show greater interest in what is being taught. They can do better on tests if they have more information to draw upon. If teachers believe that incorporating gamification into their lessons will pique students' interest, they are more likely to incorporate it.

Conclusion

The current study contributes to the existing empirical body of knowledge by further establishing the positive impact and usefulness of gamification in engineering education. Based on the study, students are in favor of adopting gamification in their classrooms and the results show that gamification helps in enhancing students programming skills. But both male and females perceived the gamification differently emphasizing the fact that gender does play a role when it comes to learning through gamified lectures and assessments. Further research could be done to understand the gender effect on selection of gamification elements to create a gamifying course to enhance programming skills. This would give us more in depth understanding of how various gamification elements could be customized according to gender to enhance learning especially in engineering education.

Limitations and Future Research

Despite of the positive findings, there were some caveats to this study. First the students' tacking of the online questionnaires were not within our sphere of control. Second we agree that a larger sample size is necessary for our results to be generalizable. Finally, we acknowledge that, in light of other investigations, our intervention was rather brief (a full semester). However, the results of this brief analysis helped to reveal a beneficial effect.

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