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# Gamified Learning Environments in Mathematics: Their Impact on Student Engagement and Error Correction Behavior

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**Abstract**
Gamification has been shown as a very effective pedagogical approach to address low motivation and deep-rooted error patterns among students of university mathematics courses during the recent past. Though the universality of mathematics as a discipline has been recognized and accepted for a long time, most traditional modes of teaching still fail to motivate students and support their error correction processes. This study investigates the impact of gamified learning environments on first-year mathematics majors' motivation and error-correction behavior at the Department of Mathematics, College of Education for Pure Sciences, Wasit University, enrolled in evening study programs. The experiment involved a total of forty students, where a pre-test as well as a post-test approach was adopted for analyzing their mathematical abilities before, as well as after, being imparted a teaching environment that included elements of gamification. The results revealed that owing to the inclusion of elements such as point systems, badges, problem-solving exercises, and so forth, there was a substantial increase in active participation in class discussions. Apart from that, there was also a marked reduction in the number of errors made by most of the students involved while carrying out math problems. The findings obtained indicate that the application of gamification in the learning process not only makes the acquisition of knowledge more interactive but also leads to the students being able to revisit their errors in a more organized way. The study concludes that the application of gamification in the entire mathematics learning process may be an effective approach for motivating the students apart from error correction, especially among those students who attend evening classes and are possibly already very tired and demotivated.

**Keywords:** Gamification, Mathematics Education, Student Engagement, Error Correction, University Students, Evening Study.

## 1. Introduction

Mathematics teaching has long been considered to be among the most challenging fields in the overall domain of educational research and practice. Despite its central place in building logical argument, problem-solving skills, and scientific literacy, students of all levels are continually pushed to work with mathematical content and typically exhibit long-standing misconceptions and mistakes (Boaler, 2016). For postsecondary education, these challenges can be intensified for students enrolled in demanding courses such as mathematics majors, in which there is a need for high levels of understanding complex concepts (Beswick, 2011). Traditional lecture-based pedagogic approaches, in which drill and practice as a means to rote memorization is prevalent, have been criticized for failing to facilitate extensive interaction or fostering sound error correction mechanisms (Sung & Hwang, 2013). Therefore, educators and researchers have sought alternative means to engage math classes and assist students in learning understanding and regulation of learning habits.

Among the more recent methods which have attracted growing interest is gamification — the use of game mechanics in non-game contexts (Deterding et al., 2011). Utilizing such features such as points, levels, badges, leaderboards, and dynamic challenges, gamified learning environments are created to leverage the motivational power of games in order to engage students with sustained participation and active involvement (Domínguez et al., 2013). Studies in a variety of fields of education have demonstrated gamification to increase learners' intrinsic motivation, support persistence, and improve enjoyment of learning (Hamari et al., 2014). Within mathematics education in particular, more recent studies demonstrate gamified approaches to enhance problem-solving skills and enable more conceptual knowledge (Clark et al., 2016). But while these encouraging results are reported, more context-specific evidence remains to be seen, especially in developing country settings and in university math classrooms where gamification is not yet being optimally used.

In Iraq, and in Wasit University too, the majority of students who participate in evening classes are subjected to other learning obstacles, including daytime work commitments, fatigue, and fewer self-learning hours. These are chiefly conditions that ultimately result in reduced classroom activity and repetition of the same mistakes with inadequate corrective feedback. It is with such challenges that it becomes an essential need to determine whether relatively newer methods such as gamified learning can aid in alleviating such chronic issues. The challenge that therefore provides motivation for this study is about the low level of active participation and significant rate of uncorrected errors by first-year math major evening classes students that may deter their performance academically and reduce their confidence in the subject.

In this context, this study attempts to investigate the impact of developing a gamified environment on the participation as well as error correction attempts among the first year students at the Department of Mathematics, College of Education for Pure Sciences at Wasit University. The main aim is to see if gamification can be effectively utilized to create a more interactive environment to facilitate active as well as systematic error correction attempts by the students. By identifying this particular objective of this study, this research adds to the existing body of knowledge of student-centered learning. The research questions were proposed as follows:

1. How does the inclusion of the concept of gamification in mathematics teaching influence the level of participation of fresh students pursuing mathematics in the evening study programs at Wasit University?
2. How does a gamified learning environment influence students' ability to identify and correct mathematical errors compared to traditional instruction?

The study is deliberately crafted to be specific to the context of bachelor-level students in their first year who enroll in the mathematics department's evening study program offered at Wasit University. These students were picked as they comprise a unique group with different learning difficulties and motivation requirements. A mathematics achievement test was conducted to gather data for both the pre-test and the post-test so that both the outcome indicators and error correction can be evaluated.

The relevance of the study is derived from its capacity to provide contributions to math educators in relation to teaching practices, owing to the fact that traditional methods of teaching tend to be ineffective in some circles when it comes to disengaged students and persistent mistakes. By undertaking an empirical study on the effect that gamification has on prominent learning behaviors, this particular study presents a number of insights that will serve to guide mathematics educators interested in modifying their approaches to cover more interactive teaching strategies (Kapp, 2012). The results also serve to stimulate decision makers in universities to promote gamified content in normal curriculum studies, thus bringing an improvement in the level of learning mathematics in higher institutions.

Briefly, the study represents the location of the intersection of mathematics education pedagogy practices and innovation in education since the study responds to a pressing need for tools that have the potential of maintaining the interest of students as well as enhancing their results under difficult conditions of learning. With the interlink of the theoretical motivation for learning as well as the cognitive-learning approach in class implementations, the study has the potential of proving that environments that are well-structured for gamification have the ability of acting as tools for changing the approach of students towards mathematics as well as their self-correcting approach towards error (Plass et al., 2015). The results of the study have implication far much beyond the teachers of Wasit University but also for teachers in the related field who are looking for an approach to make mathematics appealing to students.

## 2. Literature Review

### 2.1. Introduction to Gamification in Education

Gamification emerged within the past years as a trend and phenomenon aimed at trying game-like mechanisms and their application within the concept of enhancing engagement within a non-game context itself (Zainuddin et al., 2020). The theoretical basis for the concept of gamification depends upon theories including Self-Determination Theory, where the idea was put forth by Ryan and Deci, 2000, claiming the design of the games had the ability to encourage students' intrinsic needs of "relatedness, autonomy, and competence" and thus better engage them (Mekler et al., 2017). In universities, gamification was applied to multiple courses, and positive findings emerged regarding continuing, engagement, and motivation among students (Osatuyi et al., 2018; Koivisto & Hamari, 2019). The effect of dimensions regarding appropriate learning and the ability of students correcting their errors, however, was left as an undertaking of the current literature surveying this phenomenon (Hanus & Fox, 2015).

**2.2. Theoretical Foundations of Gamified Learning**

At the root of gamified learning are the cognitive and motivational theories, the latter of which interpret the usefulness of game-like contexts towards learning achievement. As interpreted from Mayer (2014), the theory of cognitive load holds the belief that the instructional process must ensure reduced levels of undesirable and unnecessary cognitive load while promoting desirable and necessary levels of schema construction. On the motivated side, theories point out the use of the tag, leader, and progress bars, among others, and the way they entice learners while activating their externality-driven motivations (Sailer et al., 2017). The synchronicity of the two, however, plays an important role, especially within the context of math, where learners immediately lose interest because the topic is either challenging or boring for them (Papastergiou, 2009).

**2.3. Gamification in Mathematics Education**

Despite extensive uses in vocational training, language acquisition, and other areas, the application of gamification in mathematics learning has also gained momentum due to the necessity for an element of reality in mathematics learning (Su & Cheng, 2015). It has been proven that gamification activities and websites are capable of upgrading students' attitude toward mathematics and optimizing class environments (Toda et al., 2019). For example, Kyewski and Krämer (2018) concluded that university students in a gamified e-learning environment for statistics were more engaged and spent more time on task than students in non-gamified versions.

While these encouraging trends exist, there are some cautions from studies that poorly executed gamification can derail fundamental learning objectives if students solely engage with extrinsic rewards at the expense of content knowledge (Hanus & Fox, 2015). Thus, successful gamification in mathematics must be deliberately integrated with instruction goals and supply authentic feedback instead of inserting surface-level game features (Dichev & Dicheva, 2017).

**2.4. Student Engagement in Gamified Contexts**

Engagement is a multidimensional concept that includes behavioral, emotional, and cognitive engagement with learning activities (Fredricks et al., 2004). Empirical results indicate that gamified settings promote all three aspects of engagement. For example, Seaborn and Fels (2015) thought that points, badges, and leaders can enhance behavioral engagement through multiple attempts and competition. Emotional engagement can be further amplified when students have fun and are in a state of flow when playing the gamified environment (Hamari, 2015). The concept of cognitive engagement or deep processing and strategic learning is amplified when gamified learning is developed to be appropriate with defined goals and goals (Subhash & Cudney, 2018).

In the field of mathematics, for instance, several researches have shown the positive impact of gamification in relation to engagement. Hursen and Bas (2019), for example, said that the implementation of gamified quizzes in math classes of high school students improved their engagement performance in class while diminishing off-task behavior. Likewise, the computer-based study of Chen and Law (2016) introduced the enhancement of motivation and effort in problem-solving for elementary school students in mathematics through computer-based game-learning methodology. This result was supportive of the meta-analytic findings of the moderate to large impact of gamification on student motivation for STEM fields (Sanchez et al., 2020).

**2.5. Error Correction Behavior in Mathematics Learning**

Learning math can be subject to certain systematic errors caused by misconceptions, careless errors, or procedural misconceptions (Radatz, 1983). Error correction is pointed out in the literature as a major aspect in promoting math proficiency, and the ability to identify and assess their own mistakes in math is expected to lead to self-regulated learning (Borasi, 1994). However, the learning tradition in math dismisses the necessity for error analysis in favor of correct answers without unpacking the underlying reason for the mistake (Koedinger et al., 2013).

Current best practices for pedagogy include formative assessment, immediate feedback, and example work-outs as ways to avoid errors and promote conceptual understanding (VanLehn, 2011). Gamification can aid by taking advantage of feedback and reward systems for correct reasoning moves (Kim et al., 2018).

**2.6. Integrating Gamification for Error Correction in Mathematics**

In fact, few studies have focused on the impact of gamification on the behavior of students in math error correction; this indeed appears to be a gap that this study could wish to fill. Indirect evidence, however, brings

in some avenues of hope. Mekler et al. (2013) found that feedback in gamified settings made learners study the mistakes more seriously and retry harder than in a non-gamified setting. Besides, in a study by Xu et al. (2021) which featured adaptive gamified quizzes with explanations and hints, it was shown that learners could identify misconceptions and apply the corrections themselves.
It should thus ensure that the design of the gamified error correction environment favors formative assessment over summative assessment, enabling students to make errors without consequences (Kuo and Chuang, 2016). Such attributes as receiving immediate feedback, retry, and dynamic difficulty would help ensure that it is an experimental environment (Hakulinen et al., 2015). This accords with the existing literature that emphasizes mathematical learning and the need for frequent reinforcement and metacognitive processes in learning complex mathematical ideas (Fuchs et al., 2010).

**2.7. Research Gaps and Justification**

Even so, some level of evidence exists that supports gamification in terms of engagement and motivation in relation to learning, yet whether it has an improvement in relation to error correction in math concepts remains unexamined in terms of in-depth studies, especially in higher education or in developing countries. This particular approach seems to focus on primary or secondary levels in terms of engagement metrics rather than error correction (Chen et al., 2020). Moreover, contextual and cultural considerations could affect how students respond to gamified learning approaches (Rabahallah et al., 2022). Hence, gaining empirical knowledge from contexts such as Iraqi universities is key to ascertaining the feasibility and impacts of gamified learning in regional contexts.

This research fills the gaps that have been realized through examining the impact of a specially designed gamified learning environment on students' motivation and error correction for first-year mathematics majors who are pursuing an evening study program at Wasit University. Through the positioning of the study within both culturally sensitive and practically demanding context, this research hopes to offer new insights to the global gamification and math pedagogy practice debate.

**3. Methodology**

**3.1. Research Design**

This study employed quasi-experimental design one-group pre-test and post-test to assess the effect of a gamified learning environment on students' engagement and error correction behavior in mathematics. Quasi-experimental designs are typically used in education when random assignment is not preferable but controlled interventions are available (Creswell & Creswell, 2018). Applying such a design allows the researcher to depict changes made by the intervention by quantifying the students' level of engagement and performance prior to and following the gamification intervention (Ary et al., 2018).

**3.2. Participants**

The population was 40 first-year undergraduate students of the Department of Mathematics, College of Education for Pure Sciences, Wasit University. The students were all registered in the evening study program for the 2024–2025 academic year. Voluntary participation was noted, and informed consent was obtained from each student prior to data collection. The participants constituted a relatively homogeneous sample in age (18–22 years) and prior mathematics performance, which minimizes confounding variables for purposes of heterogeneous academic preparation (Fraenkel et al., 2019).

**3.3. Instruments**

Two primary instruments were developed to obtain data: a mathematics achievement test and an engagement questionnaire.

1. Mathematics Achievement Test

The tool consisted of 25 multiple-choice and short-answer questions on basic algebra and calculus content aligned with the curriculum. Questions were framed to detect correct problem-solving skills as well as to detect the occurrence of common errors in order to enable researchers to analyze changes in behavior of error correction (Brookhart, 2017). It was checked for content validity by three mathematics education experts to verify it and piloted with an equivalent group of students to test reliability, which produced a Cronbach's alpha coefficient of 0.82.

2. Engagement Questionnaire

Student engagement was also evaluated with a revised Student Engagement Scale (Fredricks & McColskey, 2012). The self-report questionnaire consists of 20 items across three subscales: cognitive engagement, emotional engagement, and behavioral engagement. Answers were rated on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." The survey had good internal consistency and Cronbach's alpha of 0.88.

### 3.4. Gamified Intervention

The intervention was a gamified learning module that was specially designed and incorporated into their mathematical learning activities for a period of four weeks. The gamified environment featured components such as points, badges, and leaderboards, with tools for instant feedback available using a Learning Management System (LMS) that was complemented with gamification plugins (Domínguez et al., 2013). The whole curriculum was transformed into an interactive learning and challenge that the students were supposed to solve in order to get instant feedback and points accordingly.

Moreover, the quizzes supported "second chance" rewards, wherein a student was able to see his/her errors and provide improved responses, thereby motivating students for error correction with the goal of active learning (Hattie and Timperley, 2007). The tutorial was conceptualized in such a way that it struck an optimal blend of external motivational reward and master and self-regulation attempt, as supported by the recent literature on gamification (Nah et al., 2014).

### 3.5. Procedure

Pre-intervention, students completed the pre-test and the engagement survey in a timetabled class session. The gamified learning module was then deployed over four weeks, in two 90-minute sessions per week. The course lecturer, trained to deliver gamified content, and monitor student interaction via the LMS, delivered the sessions. During the intervention, students were encouraged to collaborate, compete, and learn from their errors via embedded feedback features.

At the end of the four weeks, the same math test and engagement questionnaire were readministered as post-tests. To control for test effects, the test items were rearranged and some numerical values were altered without changing the difficulty level.

### 3.6. Data Collection and Analysis

Pre- and post-test quantitative data were contrasted through paired-sample t-tests to determine statistically significant differences in student performance and error correction ability before and after the gamified intervention. Engagement questionnaire data were contrasted by obtaining mean scores for each subscale and conducting paired-sample t-tests to compare changes in levels of behavioral, emotional, and cognitive engagement.

For ensuring statistical integrity, normality and homogeneity of variance assumptions were assessed prior to analysis. Effect sizes (Cohen's d) were calculated to measure the size of changes observed. Statistical analysis was performed on SPSS version 26.0.

### 3.7. Ethical Considerations

Ethical permission for the study was obtained from the College of Education for Pure Sciences Research Ethics Committee of Wasit University. Participants were informed about the purpose of the study, that their involvement was voluntary, and they could withdraw at any time without penalty. Confidential treatment of the data of the students was maintained during the research process (BERA, 2018).

## 4. Results

This report presents in-depth analyses to address the research aims: (1) the assessment of the effect of gamified instruction on mathematics achievement among students; (2) the shift in error correction behavior; and (3) the assessment of gains in behavioral, emotional, and cognitive engagement. Descriptive statistics, inferential tests, and correlation are presented.

### 4.1. Descriptive Statistics

**1. Mathematics Achievement**

Descriptive statistics for students' mathematics test scores before and after the gamified intervention are displayed in **Table 1**.

**Table 1**

Descriptive Statistics for Mathematics Achievement Scores

| Test | N | Mean | SD | Minimum | Maximum |
|---|---|---|---|---|---|
| Pre-test | 40 | 51.85 | 6.92 | 40 | 63 |
| Post-test | 40 | 77.55 | 7.25 | 63 | 91 |

Students' mean achievement increased by approximately 26 points after the intervention, with post-test scores ranging from 63 to 91 compared to pre-test scores of 40 to 63.

**2. Total Errors**

The mean frequency of errors decreased sharply following the intervention, as summarized in **Table 2**.

**Table 2**

Descriptive Statistics for Total Errors in Mathematics Tests

| Test | N | Mean | SD | Minimum | Maximum |
|---|---|---|---|---|---|
| Pre-test | 40 | 12.10 | 2.85 | 7 | 17 |
| Post-test | 40 | 3.15 | 1.35 | 1 | 6 |

This reflects a reduction of about 74% in overall errors.

**3. Student Engagement**

Students' engagement levels improved across all dimensions. **Table 3** shows means and standard deviations for behavioral, emotional, and cognitive engagement.

**Table 3**

Descriptive Statistics for Student Engagement

| Engagement Dimension | Pre-test Mean (SD) | Post-test Mean (SD) |
|---|---|---|
| Behavioral Engagement | 3.09 (0.52) | 4.13 (0.47) |
| Emotional Engagement | 3.04 (0.49) | 4.08 (0.46) |
| Cognitive Engagement | 2.95 (0.51) | 4.01 (0.44) |

All dimensions show a mean increase of about 1 point on the 5-point scale.

**4.2. Inferential Analyses**

**1. Paired-Sample t-Test for Mathematics Achievement**

A paired-sample t-test confirmed a significant gain in students' achievement after the intervention:

- $t(39) = 21.72$, $p < .001$, two-tailed
- Mean difference = 25.70, 95% CI [23.29, 28.11]
- Cohen's d = 3.44 (very large effect)

This provides strong evidence that gamified activities boosted students' mastery of mathematical concepts.

**2. Paired-Sample t-Test for Total Errors**

A paired t-test also showed a significant reduction in total errors:

- $t(39) = -22.38$, $p < .001$
- Mean difference = -8.95, 95% CI [-9.78, -8.12]
- Cohen's d = 3.53 (very large effect)

Students made fewer mistakes and demonstrated better problem-solving accuracy.

**3. Paired t-Tests for Engagement**

Each engagement dimension improved significantly:

**Table 4**

Paired-Sample t-Test Results for Student Engagement |

| Engagement Dimension | t | df | p | Mean Difference | 95% CI | Cohen's d |
|---|---|---|---|---|---|---|
| Behavioral Engagement | 13.08 | 39 | < .001 | 1.04 | [0.88, 1.20] | 2.07 |
| Emotional Engagement | 12.97 | 39 | < .001 | 1.04 | [0.88, 1.20] | 2.05 |
| Cognitive Engagement | 14.41 | 39 | < .001 | 1.06 | [0.91, 1.21] | 2.28 |

The results show that the gamified design not only improved academic scores but also fostered higher levels of engagement.

**4. Detailed Error Type Analysis**

Errors were categorized to identify specific areas of improvement. **Table 5** presents mean frequencies for each error type.

**Table 5**

Mean Frequency of Specific Error Types

| Error Type | Pre-test Mean (SD) | Post-test Mean (SD) |
|---|---|---|
| Sign Errors | 3.80 (1.22) | 1.10 (0.70) |
| Operational Errors | 3.25 (1.05) | 0.90 (0.60) |
| Misapplication of Rules | 2.80 (0.94) | 0.70 (0.52) |
| Omissions | 2.25 (0.87) | 0.45 (0.51) |

All error types showed significant reductions ($p < .001$). The largest absolute drop occurred in sign errors, highlighting improved attention to mathematical operations.

**5. Correlation Analyses**

Pearson correlations examined relationships between post-test achievement and engagement dimensions.

**Table 6**

Correlations Between Post-test Achievement and Engagement |

| Variable Pair | r | p |
|---|---|---|
| Achievement & Behavioral Engagement | .70 | < .001 |
| Achievement & Emotional Engagement | .68 | < .001 |
| Achievement & Cognitive Engagement | .73 | < .001 |

These strong, positive correlations confirm that higher engagement aligns with better academic outcomes.

**6. Robustness Checks**

Normality (Shapiro-Wilk) and homogeneity (Levene's test) assumptions were met ($p > .05$). No influential outliers were detected. These checks confirm the validity of the results.

**4.3. Summary**

Overall, the findings show that:

- Gamified learning substantially increased mathematics achievement (large effect).
- Students corrected errors more effectively, reducing mistakes by nearly three-quarters.
- Engagement improved across behavioral, emotional, and cognitive dimensions.
- Higher engagement levels were strongly linked to higher scores.

Together, these results highlight the practical benefits of gamification in mathematics education for first-year university students.

**5. Findings and Discussion**

This section synthesizes the main results in light of the research objectives, relates them to previous studies, and discusses their implications for mathematics teaching and learning.

**1. Impact on Mathematics Achievement**

One of the most prominent results that can be garnered from this research is the marked improvement that was seen in the outcomes of the students when it came to mathematics, and this was when they were subjected to teachings that used gamification. There was a marked improvement from the mean score of 51.85 in the pre-test to 77.55 in the post-test, and this was by a mean score improvement of 25.70. This has been reflected by the huge value given by the effect size (Cohen's $d = 3.44$), and this aligns with the fact that the said studies were able to show that gamification was able to bring about more motivation and processing when it came to mathematical concepts (Ibáñez et al., 2014).

All the above findings authenticate the saying that points, leader boards, and feedbacks can and have been used for the enhancement of the attention spans and determination of learners, as shown in Dichev & Dicheva, 2017. From the fact that scores have been rising exponentially, it is safe to say that students, rather than memorizing their answers, have developed concrete skills of solving problems. This has also been consistent with the proof provided by Su & Cheng (2015) that gamified learning contexts enhance active learning-regular practice strengthens the mastery of concepts.

Moreover, this particular study contributes to the increasing literature that emphasizes learning mathematics with gaming as an effective approach where traditional learning becomes dependent on repetitive memorization (Papastergiou, 2009). From the perspective of this sample population, having experienced mathematics as an anxiety-provoking subject prior to this particular program, this learning- gaming system has apparently turned this particular subject into an attractive activity for them.

**2. Reduction in Error Frequency and Types**

Other than the achievement results, the findings indicated a large decrease in the error rates among the students. The total mean error decreases from 12.10 to 3.15, which is a decrease by about 74%. All the categories of errors, such as the errors in signs, operations, use of rules, and omissions, had statistical significance in the decrease.

Such result justifies other researches on gamification allowing accurate problem-solving as well as personal error correction (Attali & Arieli-Attali, 2015). Contrary to the usual lecture format, which places a great emphasis on passive note-taking as learning should occur, gamification learning often involves immediate feedback to enable learners to self-correct errors (Landers, 2014).

In addition, the reduction in sign and operating errors, which was most predominant during the pre-test, also means that the arithmetic precision and attention to details in mathematics among the students were enhanced. The reduction is consistent with the efforts by Ke (2008) that revealed math education games eliminate mistakes in calculations as a result of intensive playing and corrective activities.

These results indicate that gamified practice not only encouraged students to attempt more problems, but it also improved metacognitive monitoring, an ability that is crucial for autonomous problem-solving in advanced mathematics (Plass et al., 2015).

**3. Enhancement of Student Engagement**

The second key ingredient highlighted here, and made clear from the findings, is the very strong growth of engagement of students on all three aspects of behavior, emotion, and cognition. Each of the three aspects of engagement showed a growth of a point on the five-point Likert type scalar. The scores changed from medium to very high.

Behavioral investment, also known as active endeavor and involvement in activities (Fredricks et al., 2004), was greatly intensified. Participants believed that attending classes regularly and doing assignments would increase greatly owing to the competing yet supportive environment created by the game mechanics. It aligned with the finding by Hamari et al. (2016) that points and leader boards increase participation.

The affective engagement of the students, for instance, positive affect towards the learning activities, was also improved. More interest and less anxiety towards trying math problems were shown to be experienced by the majority of the students when the learning activities are presented as challenges or games. This supports Mekler, Pilat, and Döser's (2017) result, which confirms that gamification is effective because it increases intrinsic motivation, thereby adding a "fun" component to the tasks.

Cognitive involvement, such as investment in complex problem-solving strategies (Reeve, 2012), had the most significant relative increase. Students self-reported that they involved more cognitive processing in contemplating ways to solve a problem, as well as discussions about solutions with others, indicating a heightened level of cognitive involvement that reflects a sophisticated level of cognitive processing, a notion that is consistent with Domínguez, Sau, and Román (2013) when they said that applying learners' knowledge in a bigger context is what makes learners involved in a deeper manner when a process is gamified.

**4. Relationship Between Engagement and Achievement**

The inter-correlations among the three dimensions of engagement and math post-test achievement are shown to be strong and positive. Cognitive engagement was found to be better related to achievement ($r = .73$, $p < .001$). This implies that the higher the students' engagement on the cognitive dimension during the learning from games task, the better the students' achievement scores.

This is also in keeping with the concept of engagement-achievement, proposed by Fredricks et al. (2004) and followed by Henrie et al. (2015). The preceding result indicates an element of replication, whereby enjoyment and engagement are both an outcome of good instruction. The game-designed learning environment in this study also served to promote a vicious cycle, where an increase in enjoyment yielded an experience of greater achievement, which in turn caused an individual to want to achieve more in terms of engagement.

**5. Practical Implications**

The implications of this research are multiple, particularly with regard to the instruction in mathematics. Firstly, it is a confirmation that if there is incorporation of some gamification aspects in mathematics instruction, there could be some form of learning accomplishment despite the fact that there is no revolution in mathematics subjects. The computer quiz rewards are very effective.

Secondly, it should also be noted that it is significant to emphasize that error reduction and the use of gamification merely for recreational activities and applications that have been ignored for so many years, such as a lack of precision and misunderstanding of the process. Since gamification allows error corrections on the spot, it also promotes the use of Mastery Learning, which is highly encouraged in today's mathematics education streams (Bloom, 1984).

Third, the connection between engagement and achievement makes apparent the importance of establishing a learning context underpinning intrinsic motivation for students. This assumption becomes very important within contexts where math learning is considered boring and too abstract.

**6. Limitations and Directions for Future Research**

Despite the positive findings of the study, there are several issues that have been considered. The population included only 40 students from a single institution and was limited to a single context of mathematics. Future studies should include a population of much larger size and multiple levels of the year and different contexts of math, for example, geometry and calculus.

Moreover, it is noteworthy to highlight that this study was carried out on completion of a brief period (one semester). However, longitudinal studies would serve as beneficial tools to ascertain whether these novel behaviors with respect to both achievement and participation, and self-regulation practices, can be sustained once these individuals are withdrawn from the gamified components.

However, in respect to the study conducted, although the subject of the study involved students, further studies concerning gamification should investigate the perceptions of the teachers involved in the process. However, the final conclusion that can be drawn from the discussion

**6. Conclusion**

The current research addressed the effect of gamified environments on math performances, error correction activities, and engagement among freshmen students in the Department of Mathematics, College of Education for Pure Sciences, Wasit University. The data clearly show that gamification is highly effective in overcoming long-existing challenges in math education, which include a lack of motivation, high error rates, and disengagement. The addition of points and leader boards in math class resulted in dramatic improvements in math test performances, which saw the error rate decrease by over seventy percent, and improvements in all areas related to engagement: behavior, emotional, and cognitive.

These results complement existing studies to reinforce the notion that gamified learning has the capacity to positively alter the way in which students acquire knowledge, making difficult concepts more engaging. Furthermore, the results are reflective of the value that is placed on the importance of student participation in achieving success, such that the results tend to support the notion that if the student is motivated, then the results will be more impactful. Furthermore, it is identified in the study that the process of error correction, which is normally imperceptible in the classroom, is made possible through gamification.

Though this data only included a minimal sample from a single institution for a single semester, it seems to have fruitful applications in similar environments in which traditional methods have yet to provide consistent student engagement and performance, and it seems that future studies can delve into a variety of topics such as the implications of gamification in other areas of mathematics and in advanced classes, and in what manner educators can implement game elements without decreasing strength in subject matter content.

Therefore, the application of gamified learning processes is a promising approach to mathematics teachers who want to narrow down the gap created between the learning requirements of the curriculum and the interest generated to gain knowledge in mathematics as a subject. One way to support a well-structured learning environment is through gamification itself; this process has the potential to unlock the secrets to developing effective mathematics students who would then be less vulnerable to stress factors.

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