

Gamification in a Virtual Learning Space: A Pedagogical Practice in the Pandemic Landscape

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Abstract

Students' lack of motivation can serve as an impediment to attaining desired learning outcomes. During the outbreak of the coronavirus, this dilemma has proliferated as classrooms shifted to online learning environments. Teachers were challenged in the utilization of innovative pedagogical practices to keep abreast with the current learning environment. Gamification has been used as one of the solutions to overcome this perennial challenge. However, the dearth of its effectiveness in a virtual learning setup in the course of the pandemic served as a driving force to establish the current research. As such, this study aims to measure the influence of gamified teaching strategy on students' motivation in terms of attention, relevance, confidence, and satisfaction (ARCS) in a virtual classroom. A class of senior high school students taking Science, Technology, Engineering, and Mathematics who are taking their classes virtually were selected for this research endeavor (n=35). The course content during the conduct of the study deals with two-dimensional kinematics which is a concept-driven and problem-solving-oriented topic in Physics. The researcher employed a one-group post-test pre-test quasi-experimental research to measure the change in students' motivation exposed from a conventional teaching method to a gamified teaching strategy. Data were analyzed using the Mann-Whitney Signed Rank test to compare the students' level of motivation before and after employing the intervention. Results of the analysis revealed that there is a significant improvement in the motivation of students in terms of attention, relevance, confidence, and satisfaction. These findings propose gamification as a pedagogical strategy that teachers can utilize to elicit learning motivation in a virtual learning space.

Keywords: ARCS Model, Gamification, Innovative pedagogy, Motivation, Online teaching, Virtual classroom

Introduction

The pandemic has drastically transformed the educational system and immensely brought a paradigm shift in teaching and learning methodologies. This unprecedented outbreak necessitated a rapid introduction of online learning modalities worldwide as a solution to prevent the spread of the novel coronavirus. The online learning modality replicates the traditional in-person setup that takes place in a virtual classroom environment through various digital platforms like Zoom, google classroom, dial pad meetings, and the like. According to Mukhtar et al. (2020), online learning provided beneficial impacts on teachers and students which include accessibility and convenience, as teaching and learning can take place anytime and anywhere. In addition, the new modality is viewed as more cost-effective since it reduced travel and other expenses. Lastly, online learning encouraged self-directed learning where students study independently.

However, the authors added that online learning poses challenges like assessment issues, misbehavior of students, and students' short attention spans. The latter problem is evident in the study of Dung (2020), where students are suffering from tiredness, boredom, and concentration loss due to long hours of online classes. A related finding transpired from the work of Mishra et al. (2020) where students reported a lack of interest and attention during online classes. This situation has become a concern as education continues to take place in an online learning environment. Elmas&Öztüfekçi (2021) pointed out

that loss of interest in lessons can gradually demotivate students to learn. In the work of Ahmad (2021), students' lack of motivation to learn can be attributed to too many lectures, difficulty in accomplishing classwork, and learning activities that are not stimulating to hold their attention. This finding agrees with the study of Elmas&Öztüfekçi (2021), which revealed that the demotivation experienced by the students in learning is linked to tasks and teaching methods. In fact, students find online teaching boring and unengaging (Dhawan, 2020). Given the aforementioned, Nair (2021) claimed that student engagement, motivation, and attention-grabbing are the main issues in online course delivery in times of the pandemic.

In the sudden shift to online education, teachers were also faced with the challenge of applying new teaching methods that would match the current classroom setting (Rosalina et al., 2020). Nieto-Escamez&Roldán-Tapia (2021) added that it was difficult for teachers to find ways of increasing students' motivation in a virtual learning environment. As online learning modality continues to be a trend, different teaching approaches are also being developed to elicit motivation among technologically-dependent students. From this, gamification emerged as an innovative pedagogical strategy to improve learning outcomes (Seaborn&Fels, 2015; Tan, 2018; Koivisto&Hamari, 2019). Boudadi& Gutiérrez-Colón (2020) defined gamification as an educational approach that incorporates game components like point systems, leaderboards and badges into the conventional method of instruction. Dincer (2021) asserted that gamification is not about a game but about the use of game elements in a non-gaming context. The author added that it is a method in which game elements are processed for better transfer of knowledge.

During this time of the pandemic, gamified learning strategies were widely used in different disciplines to target learning objectives relevant to the needs of the students. In particular, da Silva et al. (2020) designed an interactive game-based application that aimed to help students review concepts related to intermolecular forces. The application used gamification elements such as collaboration, competition, challenge, points, and leaderboard. The game had students competing against one another to correctly answer various quiz questions. In a Likert-style survey, the students gave the game very high marks for design, substance, gameplay, and effectiveness as a teaching tool. The study showed increased motivation through competition and leaderboard while improving learning.

In addition, Fontana (2020) developed a gamified activity based on software designed for drawing molecules with the aim of making students get practice using this tool to develop their skills in organic chemistry. Videoconferencing software (Zoom) was used to enable real-time classroom participation. Students competed to accurately draw the chemical structure of molecules in advanced rounds, which presented molecules that were progressively harder to draw. The gamified activity increased engagement, improved class morale, and developed enthusiasm toward the course. In addition, chemistry crosswords have been used for a long time, and their effectiveness has been described as a tool for learning during the COVID-19 pandemic. Pearson (2020) used crossword puzzles as a model of remote active learning for first- and second-year undergraduate pharmacy students. Chemistry-themed crossword puzzles were delivered via the eBlackboard site and used to supplement lectures and problem content. The study showed that a larger percentage of students got higher marks in their exams after crossword exposure compared with the previous academic year, in the absence of the crosswords. The author suggested that the crossword impacted the exam performance for at least more engaged students.

Meanwhile, Kobner et al. (2020) have described a novel case conference format to train clinical reasoning skills to a spatially distant audience. After a team of residents submits a real clinical case that challenged their clinical reasoning abilities, a different team of residents "plays" through a gamified, simulated version of the case live on a video conference call. The case concludes with a facilitated debriefing led by a simulation-trained faculty, where both the resident teams and live virtual audience discuss the challenges of the case. Participants described how the Challenging Case Conference improved their perceptions of their clinical reasoning skills. Audience members reported increased engagement compared to traditional conferences. Participants also reported an unexpected, destigmatizing effect on the discussion of medical errors produced by this exercise. Finally, Patel et al. (2020) developed a remote high-fidelity immersive case-based scenario for anesthesiology residents' training. For this, the authors adapted an existing simulation scenario based on a real clinical case. The gamified material showed a limited engagement due to the larger group but resulted in significant knowledge gain.

While the results of different studies yield a positive outcome, recent research also established otherwise. In particular, D'Angelo (2020) employed gamification to reinforce laboratory topics and the engagement of students. The author developed a series of five exercises, called "Labventures,". Labventures stories were set up as a series of webpages, and the students should complete a laboratory task choosing proper techniques. It was observed that engagement did not take place and the strategy resulted in bad performance. In line with this, Pakinee and Puritat (2021) investigated the effect of gamified and non-gamified learning for an Enterprise Resource Planning (ERP) course to motivate students to engage and participate during working from home. A test before and after each chapter and web monitoring of students' activity provided quantitative data about their performance. According to the results, the gamified e-learning group showed higher engagement during the first 2 weeks, but then it started to drop, and in the fourth week, both groups had equaled their activity. The authors referred that the gamification strategy increased students' activity in the short term.

Moreover, Lelli et al. (2020) addressed the concept of Emergency Remote Teaching (ERT) as a temporary shift of teaching in crisis circumstances and involves the use of fully remote teaching solutions. The authors described a gamification methodology for two Computer Science courses by using ClassCraft, a free educational platform from Google that works as a virtual classroom. This platform allows the teacher to assign tasks to the students and enables the use of asynchronous (forums, videos) and synchronous tools and a score based on the accomplishment of the tasks. A number of modules that served as missions with different tasks were defined according to the course content, and game levels for each module were set as students progressed through tasks. The authors stated that the use of this gamification tool was effective to engage the students during the pandemic. Some students pointed out gamification as a positive experience to learn remotely. However, the number of students who participated in the remote activities decreased after some time, with some students reporting no physical or psychological conditions or interest in following the gamification activities. It was observed in this study that students had difficulties to understand the purpose of using asynchronous tools, such as forums.

In a further review, Lobet et al. (2020) developed a biological treasure hunt activity for 346 first-year biology students by using QuoVidi, an open-source web-based platform. This platform was conceived to teach biological vocabulary and observe the surrounding natural world. Students received a list of quests that addressed botanical and zoological terms. Students showed a good performance as the majority of pictures submitted in the treasure hunt activity were correct. Nevertheless, performance was less accurate for the photography quiz, probably due to different levels of engagement. Regarding students' feedback, 91% reported liking the activity and having learned from it, although there were two main criticisms, that the activity took so much time and some students had the feeling that they did not truly learn. Meanwhile, Liénardy and Donnet (2020) provided first-year Computer Science students with a set of gamified homework exercises, they called GameCode, aimed at teaching an appropriate methodology for programming. The exercises were inspired by GameBooks in which the reader can choose the path to complete the story. Students could choose their own solving path for each exercise and do it at their own pace. The authors reported that few students took part in the exercises, as many students had abandoned their courses, supposedly a consequence of the loss of motivation by the COVID-19 lockdown.

In summary, students' motivation has declined in the pandemic era as education suddenly shifted to online learning. This also poses a challenge for teachers introducing pedagogical practices in a virtual learning environment. Prior to the adoption of virtual classrooms, gamification has become a solution to alleviate students' motivation to learn. However, research on the effectiveness of this strategy in a virtual learning environment remains limited.

Objectives of the Study

This study generally aimed to assess the effectiveness of gamification as a teaching strategy in a virtual learning classroom. Specifically, it sought to determine students' level of motivation in terms of attention, relevance, confidence, and satisfaction. The study also intended to measure the influence of the

gamified teaching strategy on the motivation level of the students to learn the course content in view of the different constructs. The researcher hypothesized that the motivation of students in each construct before and after being exposed to the gamified teaching strategy does not significantly differ.

Methodology

Research Design

This study employed quasi-experimental research since the respondents considered in this work were not randomly assigned to conditions prior to the conduct of the intervention. In addition, this utilized a one-group pre-test-post-test design to investigate the effect of gamification on students' motivation in learning the concept of two-dimensional kinematics in the field of Physics.

Respondents

The respondents of this study are senior high school students ($n=35$) under the Science, Technology, Engineering, and Mathematics Strand in a select University in the Cordilleras, Philippines. The students are taking their classes online which is suitable for this study as the intervention is conducted through an online platform. The students were taught with lectures and gamified teaching strategies in different phases.

Instrument

The researcher adapted a questionnaire developed by Haruna et al. (2019). The items under the motivation component were selected to reflect the objectives under study. The motivation component has four constructs namely attention, relevance, confidence, and satisfaction. The overall scale reliability statistics indicated a Cronbach's alpha of 0.92, which is described to be excellent. Furthermore, the subscale reliability for attention is 0.92, relevance is 0.93, confidence is 0.90, and finally, satisfaction is 0.85. In general, the questionnaire is reliable for utilization.

Data Analysis

The data gathered were subjected to normality testing using Shapiro – Wilk Test. The normality analysis showed the data do not follow a normal distribution. Thus, the researcher used Mann-Whitney Signed Rank analysis which is a non-parametric test to compare the students' level of motivation before and after being exposed to the gamified teaching strategy.

Results and Discussion

In the first phase of this study, the respondents were taught using the conventional method for two weeks. On the last day, the questionnaire was administered to determine their level of motivation.

Table 1. Level of Motivation for the Conventional Teaching Strategy

Motivation Constructs	M	Description
Attention	2.79	Moderate
Relevance	2.73	Moderate
Confidence	2.69	Moderate
Satisfaction	2.01	Low
Overall	2.58	Moderate

Table 1 shows the level of motivation of the students in each construct. It can be noted that the students manifested a low level of satisfaction ($M=2.01$) with the conventional teaching strategy. Employing the same teaching strategy, the students showed a moderate degree of attention ($M=2.79$), relevance ($M=2.73$), and confidence ($M=2.69$). In general, the students have limited motivation in learning the course content in a virtual classroom during the pandemic.

In the second phase, the different groups were taught using the gamified teaching strategy for another two weeks. On the last day, the questionnaire was administered to determine their level of motivation.

Table 2 Level of Motivation for the Gamified Teaching Strategy

Motivation Constructs	M	Description
Attention	3.77	High
Relevance	3.68	High
Confidence	3.43	High
Satisfaction	3.54	High
Overall	3.69	High

Table 2 presents the level of motivation of the students in each construct. As shown, the students recorded a high level of attention ($M=3.77$), relevance ($M=3.68$), confidence ($M=3.43$), and satisfaction ($M=3.54$). These values indicate that the motivation level of the students in learning the course content through gamification is sufficient.

After employing the conventional and gamified teaching strategies, the difference in the median scores of the students considering the individual construct of motivation was evaluated using the Mann-Whitney Signed Rank analysis.

Table 3. Comparative Results for Attention Construct

Attention		<i>U</i>	<i>z</i>	<i>p-value</i>
Pre-survey	Post-survey	2	- 4.733	0.0086
2.79	3.77			

Table 3 presents the result of the difference in students' level of attention in learning the course content considered in this study. The test statistic ($z=-4.733$) is not in the 95% region of acceptance which denotes that the null hypothesis in this study is rejected. The overall result of the analysis shows that the difference in the attention of the students before and after employing the gamified teaching strategy differs significantly ($p=0.0086$). In this case, the attention of the students is statistically higher in the post-survey compared to the pre-survey ($U=2$).

In other words, the gamified teaching strategy increased the attention of the students in learning the course content. Several research during the pandemic revealed the proliferation of students' lack of attention to online learning (Dung, 2020; Mishra et al., 2020; Nair,2021). The finding of this study is meaningful as the gamified teaching strategy can possibly address this dilemma. This finding, however, refutes the finding of Baah et al., (2023) where the experimental group and control group did not show a significant difference in the attention construct of motivation. addition, Kaya and Ercag (2023) revealed that attention does not have a significant influence on students' motivation. These conflicting results may be attributed to the research design and statistical methods used in the different studies.

Table 4.Comparative Results for Relevance Construct

Relevance		<i>U</i>	<i>z</i>	<i>p-value</i>
Pre-survey	Post-survey	38	- 3.78	0.0007
2.73	3.68			

Table 4 presents the result of the difference in students' perceived level of relevance in learning the course content in line with their field. As a result of the analysis, the null hypothesis is rejected ($z = -3.78, U=38$). The computed p-value of 0.0007 is lower than the threshold of 0.005 indicating that there is a

significant difference in the students' perceived level of relevance of the course content before and after the intervention.

This implies that the way how students perceive the relevance of the course content to their field significantly increased after gamifying the teaching strategy. This is an essential construct that connects the utilization of gamification and students' realization of the application of the course content especially to their field of specialization. Previous studies found that gamification does not affect the perception of students on the relevance of the course content they are learning (Baah et al., 2023; Kaya and Ercag, 2023; Bangcaya et al., 2021). However, it is interesting to note that the current study provides a different point of view where the relevance of the course content is enhanced by the gamified teaching strategy.

Table 5 Comparative Results for the Confidence Construct

Confidence		<i>U</i>	<i>z</i>	<i>p-value</i>
Pre-survey	Post-survey	68.5	- 2.22	0.0261
2.69	3.43			

Table 5 presents the result of the difference in students' level of confidence in learning the course content. It can be noted that the post-survey score of the students ($M=3.23$) is higher than the pre-survey score ($M=2.69$). The difference is significant as evidenced by a p-value of 0.0261 ($\alpha=0.05$) rejecting the null hypothesis of this study ($z = - 2.22, U=68.5$).

These results entail that the gamified teaching strategy improves students' confidence in learning the course content. The confidence construct is a relevant aspect as it is correlated to students' motivation in achieving their learning objectives (Yunita et al., 2020). In a way, gamification is a helpful strategy for the attainment of learning goals. This supplements the work of Baah et al., (2023) who claimed that challenge-based gamification has a positive influence on students' level of confidence toward the course. However, a recent study reveals otherwise as confidence was found not to be a significant attribute of learning the course online (Kaya &Ercag, 2023).

Table 6 Comparative Results for the Satisfaction Construct

Satisfaction		<i>U</i>	<i>z</i>	<i>p-value</i>
Pre-survey	Post-survey	255	4.7703	0.000
2.01	3.54			

Table 6 shows the result of the analysis comparing the students' level of satisfaction in learning the course content before and after the intervention. The Mann-Whitney coefficient of $U = 255$ at $z = 4.7703$ provide evidence to reject the null hypothesis. The score of the students is significantly higher in the post-survey compared to the pre-survey ($p=0.000, \alpha=0.05$).

The gamification employed in this study increases students' level of satisfaction in learning the course content. This confirms the findings of Baah et al., (2023) where gamification was observed to improve the satisfaction of students in learning. This is also the result of the regression analysis conducted by Kaya and Ercag (2023) which showed that gamification has a positive significant impact on students' learning satisfaction.

Table 7 Comparative Results for the Overall Motivation

Motivation		<i>U</i>	<i>z</i>	<i>p-value</i>
Pre-survey	Post-survey	397.5	-7.8645	0.000
2.58	3.69			

Table 7 reflects the result of the analysis comparing the students' level of motivation in learning the course content using conventional and gamified teaching strategies. The computed z value of -7.8645 is not lying in the 95% acceptance region denoting that the null hypothesis is rejected ($U=397.5$). This provides evidence that the students' post-survey score is statistically higher than their pre-survey score ($p=0.000$, $\alpha=0.05$).

The gamification reinforces the students' overall motivation in learning the course content in a virtual classroom. In times of the pandemic, the same result transpired in the study of da Silva et al. (2020) where the motivation of students to learn online was increased by a competition-based gamification strategy. In the recent year, similar results emerged in the individual work of Baah et al., (2023) and Kaya and Ercag (2023) providing evidence that gamification strategies are salient factors that enhance student learning motivation.

Conclusions

This study focused on exploring the effectiveness of a gamified teaching strategy in improving students' motivation to learn in a virtual learning space in times of the pandemic. The study construes that the gamified teaching strategy can be an alternative innovative pedagogical practice to conventional lectures in sustaining students' learning motivation in a virtual environment. The researcher concludes that the gamified teaching strategy is effective in enhancing the students' attention, perceived relevance, confidence, and satisfaction in learning the course content about two-dimensional kinematics. Indicatively, gamification is a more effective strategy for grabbing the students' interest compared to lectures in an online learning setup. Moreover, using gamification can have a substantial influence on students' perception of the meaningful impact of the course content being taught to them. Also, the students establish a stronger belief to succeed in their learning process through the gamified teaching strategy. Finally, the gamified teaching strategy is more helpful in fulfilling the learning needs of the students compared to the conventional teaching method.

Recommendations

The researcher suggests employing gamified teaching strategy in a virtual learning environment to stimulate students in learning. In addition, it is important to consider the different constructs of motivation which include attention, relevance, confidence, and satisfaction since these individually affect the learning of students. In other words, students may be motivated in terms of attention but they don't realize the relevance of the course content to their field. It is also suggested to conduct the study using different research designs and statistical approaches to provide results that can substantiate existing knowledge about the influence of gamification on motivation. Lastly, the study may be explored in hybrid and blended learning modalities.

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