

# Exploring the relationship of learning engagement, learning interaction, and learning outcomes in gamified massive open online courses

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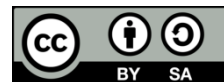
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## ABSTRACT

This study investigates the interplay between learning engagement, interaction, and outcomes within the context of gamified massive open online courses (G-MOOCs). By synthesizing literature on MOOCs, gamification, and user engagement, the research identifies significant correlations among these variables. Utilizing a structural equation model partial least squares (SEM-PLS) approach, the study analyzes data from a survey of Bachelor of Computer Science students at a technical and vocational education and training (TVET) public university. Results indicate that both learning engagement and interaction significantly influence learning outcomes, with optimal results achieved when both factors are high. These findings highlight the potential of gamification to enhance educational experiences and suggest directions for future research in gamified learning environments.

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## 1. INTRODUCTION

This paper therefore aims at an executive summary of the impact of massive open online courses (MOOCs) for learners, volunteers, and society as a whole arguing that MOOCs have emerged as a force in revolutionizing for learners in higher learning institutes. In their survey of the current practices, emerging trends, and issues of MOOCs, Voudoukis and Pagiatakis [1] note that the key change making an impact on higher education is the international accessibility of these programs. This notion of the use of MOOCs in a blended learning approach as seen in Virani *et al.* [2] portray increased willingness by educators in India to incorporate the platforms into traditional learning. This integration also shows that the sometimes-criticized MOOCs can add value and depth to the educational process. In the overall analysis that was conducted, Pampouri *et al.* [3] provide a detailed account of the differentiated nature of MOOCs whilst also exploring the nature of their development and the type of courses available. Likewise, Yemi-Peters *et al.* [4] use the concept of MOOC as a new learning technology in the post branchization phase and its relevancy to democratization of education. In this context, the view from public health suggested by Willging *et al.* [5] also suggests the capacity of MOOCs for conveying important knowledge in the specialized field.

Gamification in MOOCs is a relatively new and growing area of research that aims at increasing learners' engagement and motivation through use of the game elements. Chans and Castro [6] study has found out that the use of gamification can enhance motivation and engagement of the student's studying chemistry in the higher education. This is in line with the argument by Rohan *et al.* [7] on the theoretical continued of gameful MOOC design postulating that the complex integration of game mechanics may help promote longer learner engagement. From the same year, Dias [8] also notes that gamification can help to enhance the level of engagement for learners in MOOCs since it aligns the learning process with the elements that can be perceived as fun. In the study by Jarnac de Freitas and Mira da Silva [9] which involved a systematic literature review on gamification in MOOCs, findings showed that the use of gamified elements was positively complemented by the learners' satisfaction levels. In the work of Frau-Meigs *et al.* [10], the authors describes and reflects on the participatory challenge in MOOCs and chooses gamification as a revolutionary approach to it. Gamification must therefore be able to ascertain the learning ability of its students to cater for their needs in order to ensure they acquire mastery in those skills. All teaching and learning activities must incorporate learning theories that encompass elements of games in order to increase learner engagement [11]. It can be defined as the process of incorporating game features such as reward system, points and badges in a non-gaming environment to promote learning interactions in a specific encouraging behavior [12].

The way learners engage with the content, how they interact within the gamified MOOCs and the outcomes they produce on the learning process is a complex one that is central to the effectiveness of online learning. Lavoué *et al.* [13] examine the motivation of the learners in gamified environments and researching the connection between the observable behaviors of learners including participation and interaction to their level of engagement. Hence this research highlights the need to design gamified MOOCs that will promote intended learning behaviors among the students. This study involves a qualitative survey by An *et al.* [14] in which they assess the practices, support requirements, and challenges of utilizing gameful techniques in MOOC from the instructors' viewpoint.

Another emphasis shared by Qaffas *et al.* [15] is placed on the impact of personalization on MOOCs in increasing the learners' activity. Similarly, the application of learning analytics has been highlighted by Maher *et al.* [16] as one of the recommended pedagogical approaches of promoting learners' attention within adaptive gamified e-learning environments. Further, Hasan *et al.* [17] argued that there should be a more suitable approach to the gamification of the course in a view of the students' learning preference in a bid to make the course more personal and productive. Secondly, Chans and Castro [6] agree with this by indicating that implementing gamification to the higher education chemistry classes can boost students' motivation and engagement. Last but not least, in practice, Puig *et al.* [18] have confirmed that seller gamification on seller works, and its impact is positive for learners within online learning contexts.

In the case of gamified contents, learning engagement, interaction, and outcomes are interlinked. Thus, by incorporating aspects of gamification within the learning process not only does it add the element of fun and enjoyment which in turn increases the learners' engagement with the educational content but also promote better results in terms of learning effectiveness thus providing a more fruitful classroom experience. Altogether, the cited works help in the identification of the ways to use gamification trends in the enhancement of learning for MOOCs more effectively.

The main contribution of this research paper is to identify the significant correlations between learning engagement, learning interaction and learning outcomes in gamified MOOCs. Through the analysis of the literature concerning the respective fields of gamification, online education, and user engagement, this study establishes the impact of engagement and learning interactions to assist students in MOOC gamification. The existing studies pay limited attention to understanding the strategies for designing fun and effective gamification mechanics which is somewhat indeed shortcoming in research especially in the context of the application of gamification mechanics for online courses [19]. These results can help advance the next studies to examine and investigate the outcomes of other gamification strategies in relation to online learning, to fill current gaps in the literature and to improve the quality of the gamified learning environment.

In the remaining parts of this work, there are five other parts which are listed below. In Section 2 (Related work), the papers on related subjects are presented in a summarized way, with a focus placed on the gaps in the knowledge and the necessity of the presented research. The general idea of the experiment as well as the subjects of investigation, the tools used and the techniques applied in the study are provided in Section 3, titled Method. Quantitative data results are further discussed and aggrandized with figures, tables and statistical tests in section 4 (Results). In the final section, section 5, undertaken under the title of "Discussions and implications," the outcomes are discussed with references to the study's aims, other similar studies, and explanations could be offered for expecting these outcomes. In addition, the details of further researchers in this field are presented in the section 6.

## 2. RELATED WORK

From a usability perspective, Syahid *et al.* [20] identify the Malaysian undergraduates' perception on MOOCs; while Pozón-López *et al.* [21] investigated user satisfaction and willingness to continue using these courses. In the systematic review on learning engagement in MOOCs by Wang *et al.* [22], a survey of the available literature shows that interactive and engaging content is commendable for encouraging participation. Based on Yousef and Sumner [23] retrospective on a decade of MOOC's, there are worthwhile insights regarding the evolution of MOOCs and their implications in engineering education. As a final point, Mutisya *et al.* [24] on MOOCs in Sub-Saharan Africa to gain a small window into learners' experiences and the possibilities and changes in globalization. Altogether, these works present a multifaceted view of modern MOOCs and their potential role in the transformation of education.

Cheng [25] focuses on the impact of gamification and the possibilities to personalize such settings to obtain better learning outcomes in the case of MOOCs. Zakaria *et al.* [26] presented literature on the impact of gamification in student motivation, engagement level, and dropout rate and noted that gamification holds the promise of alleviating dropout problem among MOOCs. In this paper, Liu *et al.* [27] also elaborate on the game principle so that learners are motivated through gamification to improve learning outcomes. Atin *et al.* [28] put forward an advanced learning model for the blended teaching methodology that incorporates the concept of gamification to capture the student engagement, motivation, and learning levels. Lastly, the study of Zainuddin *et al.* [29] examines the learner engagement with gamification in online courses as well as the empirical validation of the approach. Thus, according to the literature, the use of gamification in MOOCs can be a virile tool to engage and sustain the learner interest ultimately enhancing the educational experience and performance.

While strategies for using gamification in teaching and learning processes in the context of MOOCs have gained a great interest of researchers from different fields, the results of these studies have clearly pointed to the effectiveness of gamification in augmenting students' engagement, interaction as well as their learning outcomes. Karsen *et al.* [30] presented a literature synthesis which documents that the inclusion of gamified elements positively contribute to the engagement of students in MOOCs. This is in line with the finding by Inayati and Waloyo [31] revealing that while using Quizziz, an online gamification tool embedded not only active participation in classroom but pointed to enhanced learning performance, especially in the area of online teaching of English as a foreign language. These findings indicate that when teaching and learning materials are gamified, there are high chances of encouraging learners' interest and motivation which are critical success factors for MOOCs.

To support the gamification for learning, Zhang [32] reported the benefits of gamified online learning to the learners' motivation and therefore improving the learning effectiveness. Ramansyah *et al.* [33] to this narrative by presenting the topic about interactive Moodle learning environment through using the application of gamification. Also, Chukwu [34] has presented a paper on the use of gamification to increase engagement, learning, and interaction with reference to online learning. Taken collectively, these studies support the idea that gamification as a situated approach enhances the learning interactions and spawns better educational outcomes in MOOCs, thereby altering the paradigm of learning.

## 3. METHOD

The research design was quantitative to measure learner perceptions toward gamified massive open online courses (EG-MOOC) structure. The survey instrument for this study contained 12 items, which researchers adapted using content from Watson *et al.* [35], Fotaris *et al.* [36], and Gameel [37]. The researchers distributed their survey online to 69 participants (38 males and 31 females) from the Bachelor of Computer Science course at a technical and vocational education and training (TVET) public university (Level 6). The survey instrument applied a Likert scale from 1 (strongly disagree) to 5 (strongly agree) to measure four learning dimensions that included general learning, cognitive learning, affective learning and behavioral learning. The research items measured learner satisfaction together with engagement and their perceptions of the value ascribed to gamification elements such as virtual goods, early birds, rewards, peer grading and skill point. (refer to Table 1 for a complete item list).

The survey items organize into four categories, which are general learning, cognitive learning, affective learning, and behavioral learning to ensure the questionnaire matches recognized learning theories that describe learning aspects. The survey categories assess the learner's gamified learning experience by evaluating their perceptions across four educational learning dimensions within the gamified MOOC platform (EG-MOOC). The classified sections within the framework represent separate learning dimensions, allowing researchers to track gamification's effects across these learning domains.

- a. General learning: Evaluates how learners experience and perceive EG-MOOC courses specifically through measuring course satisfaction with fulfilling learners' needs as well as enjoyment levels.

- b. Cognitive learning: The gamified course serves to improve learners' intellectual and knowledge acquisition through cognitive learning methods by evaluating subject understanding.
- c. Affective learning: Evaluates the emotional responses of learners to game elements as well as their attitudes and motivation levels to determine how gamification affect their interest in course materials.
- d. Behavioral learning: Evaluates learners' resource interaction through observable measures and analyzes the extent which gamification motivates learners to actively engage with their coursework.

The study keys survey items into different categories which gives readers a comprehensive view of the simultaneous effects of gamification on cognitive learning, emotional and behavioral responses. Researchers employed SmartPLS for structural equation modeling (SEM) procedures to evaluate the data obtained in the study. SmartPLS provided an appropriate solution for data analysis because it works effectively with small sample datasets without requiring specific distributional assumptions Ringle *et al.* [38].

Table 1. Learner's perceptions questionnaire

Variables
General learning
G1 - I am satisfied with the multimedia system course
G2 - I enjoyed EG-MOOC throughout multimedia system course
G2 - Learning through EG-MOOC meets my learning needs
Cognitive learning
C1 - I am more knowledgeable about multimedia system topics in EG-MOOC
C2 - I believe that EG-MOOC stimulates me to complete a more difficult task
C3 - I believe that gamification mechanics (virtual good) are valuable use of instructional time
Affective learning
A1 - I feel more connected to the topics in the multimedia system when using EG-MOOC
A2 - I feel confident that I can finish my assessment the day before the due date
A3 - I believe that gamification mechanics (early birds & reward) are valuable use of instructional time
Behavioral learning
B1 - I like to communicate with other learner in EG-MOOC on instructional time
B2 - I found that learning in EG-MOOC could engage me in the multimedia system course
B3 - I believe that gamification mechanics (peer grading & skill point) are valuable use of instructional time

#### 4. RESULTS

The plot of the two-way interaction effect for standardized variables contains various Excel worksheets that help interpret two-way and three-way interaction effects. The worksheet uses procedures proposed by previous researchers Aiken *et al.* [39], Dawson and Richter [40] and Dawson [41], to design interaction effects, and in terms of interaction tests, there are three (3) ways to identify significant differences between the slopes. Towards test-two-way interactions, it is often thought to be the relationship between the independent variable (IV) and the dependent variable (DV), moderated by the third variable. Figure 1 shows the two-way plot of the interaction effect for G-MOOC graph analysis. This analysis shows a significant difference in the achievement of learning outcomes when high learning engagement is given compared to low learning engagement through low learning interaction. Learning outcome achievement will be almost similar if learning engagement is emphasized through a high level of learning interaction.

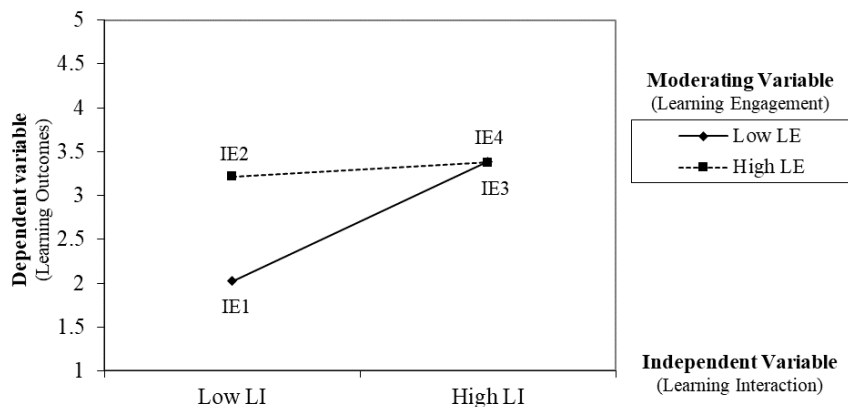


Figure 1. Plot of two-way interaction effect (IE)

Figure 1 shows a two-way interaction plot, more precisely, where the two variables in focus are learning interaction (LI) and learning engagement (LE), with the outcome variable being learning outcomes (LO). In this graph, the x-axis represents the independent variable learning interaction with two levels: The two classifications that are directly opposite to each other are low LI and high LI. The y-axis refers to the dependent variable, which has five scale values starting from 1 to 5. The two lines in the graph represent different levels of a moderating variable learning engagement; the two types of training are low LE and high LE. The trend line in the low LE graph is positive, implying that as the value of learning interaction rises, so does the value of the dependent variable. This implies that when learning engagement is high, learning interaction has a positive relationship with the dependent variable. On the other hand, the line for high LE remains nearly horizontal, implying that fluctuations in learning interaction have minimal impact on the dependent variable's values among the cohort with high learning engagement. The connection between the dependent and independent variables is dependent upon the moderating variable, as may be inferred from the above graph. Table 2 provides a summary of two-way interaction effect.

Table 2. Summary of two-way interaction effect (IE)

Hypothesis	Interaction effect (IE)	Independent variable (Learning interaction)	Moderating variable (Learning engagement)	Dependent variable (Learning outcomes)
H1	IE1	Low	Low	Low
H2	IE2	Low	High	High
H3	IE3	High	Low	High
H4	IE4	High	High	High

\*H1: There is a significant positive relationship between learning interaction and learning engagement

\*H2: There is a significant positive relationship between learning engagement and learning outcome

\*H3: There is a significant positive relationship between learning interaction and learning outcome

\*H4: Learning engagement mediates the relationship between learning interaction and learning outcomes.

Since LI is low, and LE is also low, their product LO is also low. This means that if there are inadequate interaction and participation, it inhibits achievement of the best results in learning outcomes. When LI is low and LE is high, it leads to a high LO. This means that high engagement can overcome the disadvantage of low interaction and consequently improve the results. They also discovered that high LI with low LE also result in high LO. This means that the quality of the interaction might be good enough to influence good results despite poor contact. Thus, high LI leads to high LE and hence high LO. This is the best scenario where both factors complement the other with an aim of enhancing learning outcomes.

The results of the two-way interaction effect test; this is a statistical test that helps in establishing whether there is a change in the effect of one independent variable on the dependent variable, depending on the level of the other independent variables. In this case, the independent variable is learning interaction, learning engagement is a moderating variable and learning outcome is the dependent variable. Hence, the findings indicate the significance of both interaction and engagement in the learning processes. It shows that both have a unique effect but they both work best when interaction is included along with high levels of engagement. This insight can be used in developing programs and strategies for education which supports both elements in order to improve the learning process.

## 5. DISCUSSION AND IMPLICATIONS

### 5.1. Plot of the two-way interaction effect

The positive slope of the line for low LE in Figure 1 shows that as the increase in the value of learning interaction, the learning outcome also increases. This suggests that for people who learn less, strategies that enhance learning interaction may result in more learning [42]. The slight variation in the graph of high LE implies that learning interaction hardly has an impact on the learning outcome for a learner with high levels of learning engagement. This means that to these people, the level of learning interaction may not be as critical in predicting the learning outcome [43].

Interaction effect is relevant to the understanding of this study because it shows that while learning interaction was established to be positively connected with learning outcomes the strength of this suggestion may depend on level of learning engagement [44]. This means that going for the general strategy may not be effective or even productive in the process. Some of the strategies might depend on the level of participation of the individual in learning materials. For instance, when an education system aims at promoting learning achievement, it may not be effective for people with high LE if only the level of interacting with learning is increased. For this group potentially it may be relevant to consider other options for enhancement, such as enhancing the quality of the interaction between the students and the teachers or addressing other aspects of the learning environment [45].

On the other hand, the strategy concerning increasing learning interaction for students with low LE can be effective in increasing their learning achievements. Nevertheless, it is important to understand that learning might not be solely defined by the above factors for this group. This may in some way explain why students sometimes fail to interact in class, apart from the general reasons such as learning environment, individual learning styles and personal motivation among others. In summary, knowledge of these interaction effects will be useful in designing successive interventions and increase learners' satisfaction. Through this study, the researchers and practitioners are able to get a deeper understanding of how the various factors affect learning environment and consequently, to deal with the problems.

## **5.2. Relation to hypothesis**

### **5.2.1. Hypothesis 1 (H1)**

The results support H1, which proposed a significant positive relationship between learning interaction (LI) and learning engagement (LE). The data indicates that learners with lower levels of engagement experience a notable increase in engagement when exposed to highly interactive content. This finding is closely related to the studies of [46] and [47], which reported the constructive influence of interaction learning strategies on the level of learner's motivation. Such works emphasize interaction as one of the important factors to catch the attention of learners and to engage them into active learning kind of processes. In this respect, our hypothesis holds this line of thinking to acknowledge that high quality interactivity is important for better learners' engagement and motivation in gamified MOOCs.

### **5.2.2. Hypothesis 2 (H2)**

The second hypothesis (H2), which states that learning engagement (LE) positively influences learning outcomes (LO) is also supported by the results. The graph also shows that learners who are more engaged have higher outcome rates thus supporting the previous findings by Lee *et al.* [48] which state that engagement leads to the development of deeper cognition and improved performance. It illustrates the way engagement is an important aspect of learning and raises questions as to how engagement can be maintained and intensified for MOOCs. The positive impact observed while learning indicates that strategies that are used to re-engage learners have the potential to improve learners' academic outcomes significantly.

### **5.2.3. Hypothesis 3 (H3)**

These results indicate H3 which stated a positive relationship between learning interaction (LI) and learning outcomes (LO). The study shows that whilst interaction levels are low, high interaction always results in a better learning process. Such a result fits well with current research by Barthakur *et al.* [49] that indicates that learning through interaction enhances knowledge absorption and understanding. Our study confirms this hypothesis, thus indicating the importance of interaction in the learning process, especially within environments like gamified MOOCs with a high level of learner autonomy. This type of relationship stresses how design should involve activity that leads to learner engagement.

### **5.2.4. Hypothesis 4 (H4)**

H4 suggested that learning engagement (LE) mediates the relationship between learning interaction (LI) and learning outcomes (LO). In terms of the hypothesis that is stated above, the two-way interaction plot depicted in Figure 1 offers more subtle analysis. Indeed, engagement does moderate the connection, yet this moderating effect differs with the level of interactivity. In the case of low motivated learners on the other hand, interaction raises the learning gain markedly which accumulated evidence indicates that interaction is helpful in cases where learners lack internal interest. On the other hand, for the highly motivated learners, the effects of interaction on the results are insignificant, such individuals are already willing to learn such factors as quality of interaction or the environment in which the learning is taking place matter.

## **5.3. Comparison with initial hypothesis and related research**

The findings support the initial hypotheses but also present new characteristics of the relations between the factors. Hypotheses H1, H2 and H3 had support as expected, while H4 was supported but it showed that engagement plays a partial mediator between interactivity and users' perception at different levels of interactivity. This result implies that while engagement improves results, the combined effect of interactivity and engagement is conditional on the learner's perceived motivation and engagement. Some of these findings were not necessarily assumed earlier based on the underlying research hypotheses but are important for better understanding of the specificities of gamified learning environment that ought to be designed in the future.

The findings are consistent with findings from Wang *et al.* [50] and Zeng *et al.* [51] which showed that learners' learning engagement can be enhanced significantly through effective designs of interaction. Nevertheless, our research is an extension of the first by showing that the interaction effect between LI and LO is mediated by LE which means that interactivity is more crucial for less motivated learners. Thus, the study raises the implicative argument that higher interactivity cannot be standardized and calls for approaches that distinguish between differently engaged learners. The contribution of our study is to demonstrate how interactivity and engagement are inherently related within gamified MOOCs but must be carefully organized to achieve positive learning effects.

#### 5.4. Implication

The findings of this study have practical implications for MOOC gamification design. Education stakeholders should design learning activities that are both highly interactive and elicit consumers' participation; however, they should also aim for individual differences. In the case of less 'self-regulated' learners, boosts in interactivity can be a key factor, whereas for the 'self-regulated' learner the quality and the range of interaction can be a value-added factor. These results highlight the importance of learning design that can address contextual variability in learner needs to provide more meaningful learning experiences.

## 6. CONCLUSION AND FUTURE WORKS

Overall, there is evidence of a two-way interaction effect between learning interaction and learning engagement on the dependence variable. This kind of analysis is especially useful in educational research or in interventions that seek to enhance learning outcomes by modifying the coactivity dependent on learners' level of activation. It is a useful method that helps to realize the interactions between various factors in a learning environment. The interaction effect represented in the graph shown above is a basic concept in statistics and research analysis. It is a research method that states that the relationship between an independent variable and a dependent variable may be affected by another independent variable. Future research will aim at devising new forms of learning systems that can self-adjust to these interaction effects to improve the effectiveness of learning strategies.

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## CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

## DATA AVAILABILITY

Data availability is not applicable to this paper as no new data were created or analyzed in this study.

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