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Conceptual design model of engaging gamification mechanic for online courses

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ABSTRACT

Online learning, or e-learning, delivers educational content and teaching through various formats, ranging from self-paced courses to synchronous virtual classrooms. Gamification, the incorporation of game-like elements into non-game contexts, enhances engagement through rewards, reputation points, and goal setting. In higher education, researchers seek effective methods to stimulate learning and boost learner engagement. This study employs the analytic hierarchy process (AHP) to identify suitable gamification elements for three types of learner interaction, breaking down the decision-making problem into a hierarchy. Through a pairwise comparison matrix, priorities among hierarchy elements are established. The research involves 36 learners from a technical and vocational education and training (TVET) Public University, selecting the top best six gamification mechanics for each construct: virtual goods, wally's game, rewards, trophies-badges, skill points, and peer grading. The proposed conceptual design will be implemented in online courses to assess learning engagement in cognitive, behavioural, and affective domains in higher education.

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1. INTRODUCTION

In recent years, e-learning, usually referred to as online learning, has gained popularity as an alternative to conventional face-to-face training. This tendency was hastened by the COVID-19 epidemic, which compelled colleges and universities all around the world to switch to online education. This research article covers the state of online learning research today, including successful learning strategies and best practices. The flexibility of online learning is one of its biggest benefits. Learners are free to access course materials and do tasks on their own time and at their own speed. According to Means *et al.* [1], online learning led to slightly better outcomes in terms of learner's achievement and retention. In another study, examined the fact that traditional face-to-face training cannot always be as successful as online learning [2]. However, these studies also imply that a few variables, like the standard of instructional design and the degree of learner participation, may affect how successful online learning is. The usage of online learning is proof of the fourth industrial revolution, in which there is infinite access to knowledge and online or remote

learning is possible. In these settings, learners can learn and interact with teachers and other learners from anywhere [3]. The creation of numerous academic works, concepts, prototypes, hypotheses, codes of ethics, and benchmark concentrations on high-quality online course design, teaching, and learning are all components of effective online education [4].

Gamification is becoming a solution and a more attractive choice for delivering interactive learning information, inspiring experimentation with its incorporation into teaching and learning. Gamification is defined as the broad use of game-based mechanics, aesthetics, and game thinking to inspire action, as well as gamification in problem-solving in serious games, in both business and education. The advantage of gamification is that it may make learning enjoyable through challenges, friendly competitions, and prizes; this promotes learner involvement in learning and aids in the development of good critical thinking and multitasking abilities [5]. There are several traditions that help gamify and engage learners in course material and communication [6]. Numerous gamification components are classified as self-elements and social-elements. Learners were integrated into a community via social components like leaderboards. Levels, badges, points, virtual goods, awards, content unlocking, self-secret tips, and other self-elements provide learners with a sense of accomplishment and allow them to compete against one another. They encourage learner interaction and collaboration and allow them to strive with other learners [7].

E-learning might absolutely and effectively use gamification. Learners are more motivated to learn when using the gamification environment, and this process is successful because learners generally like the game elements that are integrated into the lesson and effectively improve learner experience and engagement [8]. Gamification needs to change depending on the intelligence of the learners and offer the right teaching resources so that they can master their abilities. To increase learner engagement, learning methodologies that incorporate gamification must be used in teaching and learning activities [9].

The main contribution of this research paper is the development of a comprehensive conceptual design model for engaging the design of gamification mechanics in an online course context. By synthesizing the existing literature on gamification, online education and user engagement, this study proposes a new conceptual design model that outlines key components and principles for designing effective gamified experiences in online learning environments. This model considers various factors, such as the alignment of teaching content, a feedback system, and game mechanics, to increase learner engagement and improve learning outcomes. Additionally, this research identifies significant research gaps in the current literature. There is a lack of research on how to design and implement engaging gamification mechanics that are effective in achieving online learning outcomes, particularly in the application of gamification mechanics specifically for online courses [10]-[13]. The findings of this study can guide future research efforts to explore and evaluate the effectiveness of different gamification approaches in online education, thereby bridging existing knowledge gaps and contributing to the advancement of gamified learning experiences.

This rest of this paper contains five more sections. Section 2 (related work) reviews existing studies that have explored similar topics, highlighting the gaps in knowledge and the significance of our research. Section 3 (method) outlines the experimental setup, including the participants, instruments, and procedures used in our study. Section 4 (results) presents the quantitative findings obtained from the data analysis, accompanied by relevant figures, tables, and statistical analyses. Section 5 (discussions and implications) interprets the results in the context of the research objectives, compares them with previous studies, and offers possible explanations for the observed outcomes. Lastly, section 6 (conclusion and future works) concludes the study and propose future directions for research in this field.

2. RELATED WORK

Gamification is the use of game design elements in non-game contexts [14]. It means gamification splits up serious games and designs for playful interactions. Gamification has been proposed over the past several years as a potential approach that can motivate and engage learners in learning environments [6], [15], [16]. Gamification mechanics can be used to motivate and trigger desired behaviours in learners [17]. In the surroundings of education, gamification allows learners to have immediate feedback about their progress in the learning process and acknowledgment of an accomplished task [6].

Despite the extensive volume of research on the engagement of learners and work it is still difficult to keep learners engaged in their activities [17], [18]. Learner engagement is one of the main components of effective online learning. The widely accepted three component model often consists of cognitive, behavioural, and emotional engagement [19]. The factors such as technical problems, peers' behaviours that either encouraged or impeded learners from engaging in the gamified online discussions were acknowledged [20]. Goehle [21] finding was aligned with Barata *et al.* [22] and Engels *et al.* [23] found that the gamification approach positively influences learner engagement in an online learning platform. Furthermore, in previous research, learners reported that the gamification features were more motivating and enjoyable to use [24].

Yang and Lee [25] and Puritat [26] found that gamification elements like points, badges, and leaderboards have been demonstrated to significantly improve learner motivation, engagement, and learning results. The researcher contends that gamification might be an appropriate method for boosting online courses' efficacy. Saputro *et al*. [27] discovered that gamification increased learner engagement and motivation, which in turn enhanced learning outcomes. The finding is consistent with past studies by Puig *et al.* [28], which gamification elements such as badges and points increased learner engagement and improved learning outcomes. This is supported by Maina *et al*. [29] who revealed that the gamification and micro-credentialing significantly increased engagement, motivation, and learning outcomes for the participants. Analytical hierarchy process (AHP) is an idea selection instrument that is used to help decision makers attain the best decision by comparing each alternative. The pair wise comparison was made up for criteria, and the alternative is done based on Saaty [30]; 1-9 scale (1: equal importance, 3: moderate importance, 5: strong importance, 7: very strong importance, and 9: extreme importance).

3. METHOD

This study has three objectives to achieve towards producing a conceptual design. The objectives are: i) to identify the preferred construct for learners; ii) to determine the potential of gamification elements for online courses; and iii) to identify suitable engagement elements to validate. Two approaches were used in this study to accomplish all the three goals. The approach is a survey of the literature and AHP analysis online tools. The first approach is a survey of the literature. The survey was conducted to explore the existing gamification approach applied in online learning to enhance learning engagement. There are five steps applied in this study shown in Table 1.

Table 1. Five steps and research method applied in this study

No. of step	Research method	Description
Step 1	General database search	– Survey of the literature: to explore the existing gamification approach applied in teaching and learning to increase learner engagement – Deep exploration of the academic literature: using ScienceDirect (SD), IEEE Xplore Digital Library (IEEE), ACM Digital Library (ACM), Scopus, Springer, Emerald, Research Gate, and Google Scholar – Material types: journals, reports, conference paper, articles, books, dissertations and thesis, E-book, and working paper
Step 2	Focus search	– Exploring gamification element in learning engagement – Factors effecting engagement using online learning
Step 3	Additional search	– Direct information from researchers via ResearchGate platform to expansion more details information
Step 4	Analysis	– Data analysed through table matrix after complete reviewing papers
Step 5	Design system	– Design the engaging gamification mechanic for online courses system based on findings

The quantitative study was conducted as the second method. A research survey used an electronic questionnaire form and is implemented by using AHP online tools from www.bpmsg.com developed by [31] and Google Forms. Nine-point Likert-scale items (1-2 strongly disagree; 3-4-disagree; 5-neutral; 6-7-agree; and 8-9-strongly agree) are indicated for some questions, such as the perceptions on online skill to complete online activities, online content, internet discussion, and online course readiness. The AHP is to determine six gamification elements for three types of instruction dimensions that will be used in this study. According to Krejcie and Morgan [32], the minimum requisite sample size was 36 learners for minimum size of the population of 40 learners. The total respondents of 36 learners (10 males and 26 females) for this study were from the bachelor of computer science programme at a technical and vocational education and training (TVET) Public University (level 6) responded to this survey.

4. RESULTS

This section describes a survey of literature, AHP analysis, and mapping of literature with AHP analysis. The results and analysis for each section are presented in diagrams, graphs, and tables for easy understanding. Results for the literature study are divided into three key findings. The findings are learner interaction, gamification elements to study, and engagement elements to validate.

4.1. Survey of the literature

4.1.1. Learner interaction

The first systematic usage of interaction in this study, which consists of learner-instructor (L-I), learner-content (L-C), and learner-learner (L-L) interactions, was nonetheless suggested by Moore [33].

According to Moore [33], content is the subject to be studied. Thus, learner content is a cognitive process that broadens the learner viewpoint and learning understanding. Interaction between the learner and the content is crucial for improving understanding. To promote learner-content engagement, a range of activities should be created [2]. In addition, when a learner interacts with an instructor, the expert who is familiar with the material is sought out for advice, and the instructor serves as a counselor by offering the learner support and encouragement. The three forms of interactions that are currently being studied in Moore's model-based study on interaction in online learning are learner-learner, learner-content, and learner-instructor [34], [35]. The systematic literature review, we identified the relationship between learner interaction and engagement, shown in Table 2.

Table 2. Relationship between learner interaction and engagement element

Ref.	Type of learner interaction			Engagement element
	Learner-instructor	Learner-content	Learner-learner	
[2], [34]	/	/	/	Behaviour, cognitive
[35]	/	/	/	Cognitive, affective, behaviour
[36]	/		/	Cognitive
[37]		/		Cognitive
[38]	/			Affective, behaviour
[39]-[43]	/		/	Cognitive, affective, behaviour

4.1.2. Gamification elements to study

Gamification mechanics are those elements of game play that make them fun and engaging. Recently, there has been increased attention around gamification as a method for providing interactive, creative, and exciting content to learners. According to Zichermann and Cunningham [14], the introduction of virtual goods, badges, and point gamification element in their study boosted learner engagement and made the teaching and learning process more interesting and engaging. However, in order to increase learner engagement, engaging and entertaining activities also rely on the activity's inventiveness and gamification element presentation. The design will be highlighted in the case studies by the simultaneous use of gamification activities to encourage learner engagement and to facilitate teaching and learning.

The completion percentage of another research ranged from 73% to 97%. The investigation of how gamification features may increase young kids' participation in various activities [40]. The study included two gamification components: points and rewards. The duration, motivation, and context of empirical investigations in young children have all been noted as difficulties by researchers. To achieve a high completion rate in the case studies to be undertaken, the age factor and the right selection of acceptable gamification components depending on age are crucial. In another research, Lu and Law [44] and Wu *et al.* [45] employed the gamification aspect of peer grading. The findings indicate that learner assessors' allocation of time towards detecting issues and making recommendations is a significant predictor of both their own performance as an assessment and the impact of positive emotional feedback on that performance. Online peer-level assessments generally benefit from peer grading, which also highlights the value of different kinds of feedback [44].

Furthermore, it deepens our comprehension of how the persons involved are impacted by peer assessment. Peer grading is an interesting gamification component that should be included in the study design and will make gamification more enjoyable [45]. Table 3 displays a summary of gamification elements proposed by other researchers. Trophies, badges, and rewards were the two most recommended gamification elements by previous researchers.

Table 3. Gamification element proposed by other researchers

Ref.	Gamification elements					
	Virtual goods	Wally games	Trophies-badges	Rewards	Skill points	Peer grading
[35], [46]				/		
[45]				/		/
[47]	/	/	/	/	/	/
[48]			/	/		
[49]-[57]			/			
[22], [25], [27], [58]-[62]			/		/	
[26], [63]-[72]			/	/	/	

4.1.3. Engagement elements to validate

Engagement is more than involvement or participation; it requires feelings, sense-making and activity. The engagement indicator has been adapted in this study from engagement theory [19]. The theory

consists of three main areas, which are cognitive, affective, and behavioural. Engagement is characterised by an investment in and dedication to education, as well as by acknowledgment of and identification with an institution.

According to Appleton *et al.* [73], engagement is linked to the intended academic, cognitive, behavioural, and emotional outcomes, such as remaining in school and graduating. Engagement demands sentiment and sense in carrying out an action; it goes beyond participation or engagement. The engagement measures used in this study were modified from the engagement theory by Lu and Law [44] and Hew *et al.* [51]. Table 4 shows the summary of engagement elements proposed by other researchers.

Table 4. Engagement element proposed by other researchers

Ref.	Engagement elements		
	Cognitive	Affective	Behaviour
[44]		/	
[2], [22], [45], [51], [59], [74]-[76]	/		/
[46], [50], [58], [77]-[81]			/
[49], [82]	/		
[35], [38], [39], [41]-[43], [83]	/	/	/

The table shows the engagement elements proposed by researchers, with most of them focusing on cognitive and behavioural aspects, and fewer researchers use affective research. According to O'Farrell and Morrison [84], cognitive and behavioural components of engagement are considered some of the most critical indicators of learner engagement and achievement. The definitions of three types of engagement element are:

a. Cognitive engagement

Cognitively engaged learners will be invested in their education, strive to go above and beyond expectations, and enjoy a challenge. The goal of the gamification concept is to boost knowledge through learning activities.

b. Affective engagement

Affectively engaged learners will express their feelings in positively and negatively ways about their teachers, peers, education, and institutions. Develop a timely completion mindset in learners using gamification-based learning activities.

c. Behavioural engagement

Behaviorally engaged learners often follow behavioural expectations, such as attendance and participation, and show no signs of acting out or negatively. Gamification features are used to improve behavioural engagement and keep learners engaged in the activity and completing the task.

4.2. Analytical hierarchy process analysis

The analysis of this project's use of the AHP tools from Saaty [30] is the final step in the identification of the three key elements that will be used: learner interaction, gamification element, and engagement element. The results of analytical studies using AHP tools published through the journal by Yusoff *et al.* [85] will be used to guide the development of conceptual designs for engaging gamification mechanics for online courses. The AHP result is shown in Table 5.

Table 5. Results of previous analytical studies using AHP tools by Yusoff *et al.* [85]

No.	Learner interaction	Weight	Gamification elements	Weight
1	Learner-content	0.4488	Virtual goods	0.2587
			Wally games	0.3021
2	Learner-instructor	0.3093	Trophies-badges	0.3101
			Rewards	0.4135
3	Learner-learner	0.2419	Skill points	0.3279
			Peer grading	0.2178

The AHP analysis considers twelve gamification elements that have been selected by learners based on three types of constructs. Based on the gamification elements, only six gamification elements have been selected through AHP analysis according to the weighting of learner selection, and the gamification elements will be used in the conceptual design model. The AHP analysis study showed that the respondents selected the strength of the construct and gamification elements to produce the design of the gamification concept, which the researchers will use to produce desired online course features. The course developer will build each task following each construct and gamification element selected by the respondent.

4.3. Mapping of literature with analytical hierarchy process analysis

As a conclusion from the systematic literature review and AHP analysis, we identified that the learner interaction, gamification element, and engagement element will be used in our conceptual design, as shown in Table 6. The goal of this research was to identify the most effective gamification techniques for three different constructs. The conceptual design model for gamification will be created using the chosen criteria to achieve the desired learning outcome. In this study, we developed a generic approach for the conceptual design of an interesting gamification mechanic. This strengthens the connection between gamification and learner engagement.

Table 6. Summary of the engaging gamification mechanic design

No.	Learner interaction	Gamification elements	Engagement element
1	Learner-content	Virtual goods Wally games	Cognitive
2	Learner-instructor	Trophies-badges Rewards	Affective
3	Learner-learner	Skill points Peer grading	Behaviour

Figure 1 depicts the conceptual model which was developed using the result from the literature study, and the analysis of the AHP. It incorporates three components: learner interaction, gamification, and engagement. All those components were crafted, transformed, and adopted using Hew [35] and Chang and Wei [47] models. The approach adopted by Chang and Wei [47] included learner interaction and gamification, whereas the model from Hew [35] is built based on learner interaction and engagement features.

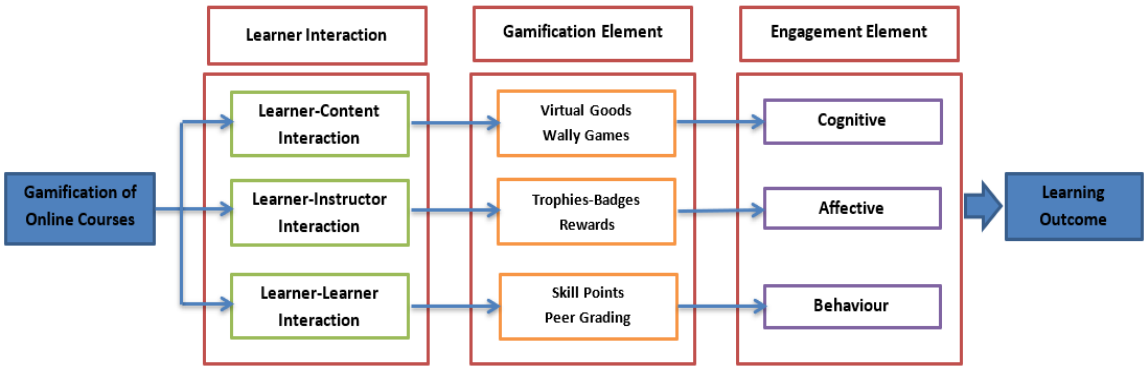

Figure 1. Conceptual design model of gamification for online courses

Chang and Wei [47] accordingly highlight the prerequisite of mapping learner interaction patterns so as to comprehend the effect of gamification on engagement and knowledge acquisition. The findings of the study proven that in e-learning environment, gamification approaches supported learner engagement. The involvement in the experience showed higher levels of collaboration, communication, and engagement when compared to traditional online learning settings. A more involved and participatory learning environment has been fostered with the addition of a game component, which offers students a sense of community, the possibility for friendly competition, and social interaction.

Other academics have looked at the concept of mapping learner interaction and engagement [51]. The incidence and quality of learner interaction in an e-learning environment are thoroughly correlated to learner engagement, as the author acknowledges. The depth and quality of interactions rather than just their quantity must be considered when mapping learner interaction with learner engagement. The intensity and quality of interaction and not just its quantity must be considered when mapping learner interaction to learner engagement. Therefore, research on these concerns includes on how interactions facilitate online learners develop their critical thinking, problem-solving skills, and subject-matter knowledge. Futhermore, instructors and trainers intend to absorb more on successful teaching and interventions strategies, and assessment

methods that encourage expressive interactions and increase learner engagement by mapping learner interaction with learner engagement.

5. DISCUSSION AND IMPLICATIONS

Online education has been really successful in the recent past due to flexibility in terms of delivery method and convenience. One of the issues with online education is the difficulty of sustaining the learner to be connected and engaged with the classes. Although gamification as an application of fillip from games in the non-game settings is an idea that shows as a solution to this problem. This article suggests a conceptual design of gamification features that should be included into online education programs.

These features can be used to increase the participation of learners as well as improve their attentiveness. The essence of the literature mapping with AHP analysis section is to build a connection between the insights and findings of the literature review which is a collection of the previous research on gamification and learner engagement with the analysis that have been obtained through them. The mapping method is used for this purpose, which helps to enrich the conceptual design model and to make the foundational theoretical apparatus for the creation of the amusing gamification mechanics for online courses. Findings from Chang and Wei [47] are very significant because they demonstrate how critical it is for educators and instructional designers to meticulously work out gamification mechanisms which can lead to improvement in interaction types of learners such as knowledge sharing and peer collaboration. In the gamified environment, clear rules and instructions are crucial for managing possible conflicts such as the excessive competition, and also for helping the learners form useful relations.

A literature review was done to find the recent studies, theory framework and industry standards of gamification and learner engagement before the AHP analysis was done. Through critical analysis and synthesis of the literature, scholars may acquire a deep knowledge of the elements that lead to a high learner engagement in their online courses and the effectiveness of employing gamification elements. Hew [35] distinguishes in her opinion learner interaction from learner engagement and views quantity of interactions as less important parameter than their quality and depth. It implies research on what kind of relationship and collaboration promote the growth of these young people's critical thinking, problem-solving skills, and knowledge. The combination of learner interaction to learner engagement enables educators to gain valuable knowledge of good teaching practices, intervention strategies, and assessment methods which promote useful interactions and enhance learner participation. After the finishing of the AHP analysis, the mapping process to this prioritization of the importance of different communication characteristics details then follows. The goal is to align the results of the AHP analysis with the following empirical facts from the literature:

a. Verification of AHP findings

A literature map, which combines AHP, is utilized to verify the factors ranking derived from the AHP methodology. If the literature keeps on emphasizing the significance of the criteria, the believability of the study is increased and their role in the creation of the entertaining gamification mechanics is improved.

b. Determination of opportunities and gaps

Another advantage of the literature mapping by means of AHP's analysis is to detect any mismatches or voids between the conclusions which AHP makes and the present study's findings. Therefore, the AHP enables the scholars to focus on the struggles in the literature and uncover relevant elements, which were not paid as much attention. This might lead to filling the gaps of the future research by new studies where the engaged learners and gamification has not been the main area focus.

c. Improvement of design recommendations

Mapping the literature with AHP analysis may be employed to extend or refine the design inputs as regards engagements of gamification mechanics. There are a plenty of academic works that discuss the use of gamification elements for the more effective application in the online courses. The researcher community has recently added a number of evidence-based, context-specific design guidance on the gamification techniques that can be fit into online courses. Such technical solutions are realized via this data and the knowledge about priorities from the AHP analysis. It also enables creation of compelling gamification mechanics of the online courses by an in-depth literature mapping backed by AHP analysis. Through connecting the gap between empirical study and practical application it becomes possible to create a system of outlined opportunities for designing successful gamified learning experience that consider both practical concerns and published findings.

6. CONCLUSION

The aim of this research is to propose a conceptual design of engaging gamification with the best gamification mechanics suitable for online courses. The top six preferred gamifications will be applied as our gamification elements to be further development in system design and development phase. Appropriate

contents and activities will be used for the gamification elements intended for online courses. For future work, research must concentrate on gamification mechanic design, indicator engagement to measure the learner engagement.

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