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Gamification Driver Soft Modelling of Learning Management Systems in Covid-19 Pandemic

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ABSTRACT

This study aims to provide a Gamification Driver Soft modelling of Learning Management Systems in Covid-19 Pandemic. By studying the theoretical foundations and experimental background and content analysis approach, eleven drivers were identified in the first phase. This study's statistical population consisted of Persian Gulf University (Bushehr, Iran) faculty members with appropriate empirical and theoretical knowledge in information systems scope. Fourteen of them were selected as sample members by purposeful judgmental sampling method. The data collection tool was a researcher-made questionnaire whose validity was confirmed by face content analysis method, and also the reliability was confirmed by inconsistency rate method. The collected data were analyzed by fuzzy interpretive structural modelling to design a Gamification Driver Soft modelling. The results showed that the driver of "learning opportunity", "appropriate design", "ease of use", "motivation" and "cooperation" which were placed in the lower levels of the model, as effective and root driver. Therefore, it is requisite to have more emphasis on these drivers when designing systems to motivate users resulting in the improvement of learning outcomes. It should be noted that the proposed research is innovative in terms of modelling Gamification driver in learning/teaching systems in the Covid- 19 pandemic. In today's digital age; ideas formation will not be possible without considering other facts in terms of emerging paradigms of technology. Gamification is a new concept of information systems in the motivational learning scope that if used in virtual learning guarantees its success as the critical element of training in the pandemic of Covid-19.

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Introduction

The intrinsic incentive is usually considered as the most productive force of individuals' behavior. Therefore, many companies, educational institutions and organizations are looking to motivate their employees and look for motivational resources (Xi & Hamari, 2019). In education, intrinsic motivation and automation of learning are considered one of the most significant points of successful and effective education. In the workplace, an employee who enjoys his work is more efficient and is also considered more successful and eligible by the organization (Isen & Reeve, 2005). Hence, the utilization of methods to enhance user engagement is considered an appropriate strategy to motivate the behavior-change and the users to perform tasks and achieve more appropriate goals. One of these methods is called gamification; which is described as the use of gaming-design elements in non-gaming contexts (Deterding & et al, 2011).

The primary purpose of gamification is to help the problem-solving process, learning promotion, and discover users' motivation (Dias & et al, 2018). Shreds of evidence suggest that human life is increasingly becoming like a game; Not only because games have become a ubiquitous part of our lives; but also because the activities, systems, and services are widely becoming a game-like process. Gamification refers to the design of information systems to create similar experiences and motivation, which is consequently trying to influence users' behavior (Koivisto & Hamari, 2019). The term gamification has rooted and derivate from the digital media industry (Rodrigues & et al, 2019). The first document on gamification was published in 2008, but "Gamification" was generally accepted by the scientific communities in 2010; while many researchers and software system developers used this term (Isen & Reeve, 2005).

The scientific community adopted the term by taking two facts into account: 1) the gradual adoption and institutionalization of social games and the influence of game elements in humans' daily life in interactions; 2) Inducing the desired experiences and motivations of users to be used in applications - in a specific perspective; online games are explicitly designed for entertainment for a long time ignoring the basic themes (Rodrigues & et al, 2019).

When people live and work in digital environments; human resource managers should utilize the tools of recruitment, training, development and other similar tools (Wong & et al, 2017). In a digitalized economy, not only are work processes and tasks increasingly digitalized; but also the workforce is also becoming more digitally indigenous. This "digitalized" workforce expects the digital power of organizations as well as free access to corporate information (Colbert & et al, 2016). Therefore, human resource managers of organizations should utilize new methods and approaches to train employees and drive their incentives. According to a recent report by the Entertainment Software Association in 2018, 60% of the US population played digital games daily (Küpper & et al, 2019). Thus, digital games represent a prominent recreational activity for a large section of society and are not limited to a specific age group (Markoulli & et al, 2017). Therefore, it is not surprising that the use of games in non-gaming fields (for example, training and learning of companies) through gaming elements has been

introduced as a recent trend in the field of human resource management of developed companies benefiting from people's interest in games to achieve goals which are irrelevant to gaming stuff (Cardador & et al, 2017).

Gamification creates intrinsic reasons for using exploratory design patterns and game dynamics to enrich users' satisfaction. Persuasive and entertaining gamification leads to excitement among users and also increases user's experiences (Cechetti & et al, 2019). However, adding game elements to the system depends on the detailed planning and analysis of the proposed gamification implementation goals (Baptista & Oliveira, 2019). Also, some researchers indicate that during gamification, users' characteristics should be considered because different types of users are affected in different ways (Cechetti & et al, 2019, Jia & et al, 2016).

Recent years have noticed an increase in the number of gamification applications in multidisciplinary fields such as commerce (Bittner & Schipper, 2014); Environmental and ecological behaviors (Prestopnik & Tang,2015); Information systems and software (Koivisto & Hamari, 2019); Risk and energy management (Bajdor & Dragolea, 2011); Mapping (Kapenekakis & Chorianopoulos, 2017); Teaching and learning (Christy & Fox, 2014, Kim, 2018, Hakak & et al, 2019, Tondello & et al, 2019); Tourism (Baptista & Oliveira, 2019); Finance and Budget (Altmeyer & et al, 2016); Marketing management (Huotari & Hamari, 2017); Health and medical issues (Fleming & et al, 2017); human resource management and job analysis and design (Kim, 2018). The Covid-19 has closed universities in 188 countries or caused serious changes in their higher education system. According to UNESCO, more than 1.5 billion students (more than 91% of the world's students) have been affected by the Covid-19 pandemic, and their educational systems have undergone serious changes. Changes that have been made either publicly, governmentally or by universities and training centers. With the lockdown of the university and the impossibility of providing face-to-face and participatory education, the world's universities have lost the possibility of continuing their normal activities in various fields, and the need to continue education and research of each of these institutions leading to an increasing effort to explore alternative solutions. In general, the evident fact is the rapid movement of universities towards e-learning and the utilization of distance-learning and management equipment. The quality of education is increasingly important for the success of educational institutions. In this context, the use of games in education (gamification) is a tool that is often used to help to improve the process of teaching and learning that professors and students achieve their goals in the short, medium and long term. Considering the importance of this issue in the university and society, this study has systematically reviewed the literature on the use of gamification as a tool to improve the quality of the educational process. Therefore, this study aims to design an interpretive structural model of gamification driver for learning/teaching systems in the Persian Gulf University in the Covid-19 pandemic condition.

Literature Review

Since the introduction of game development in the early 2000s, has become a substantially successful and popular scope for managers (Werbach & Hunter, 2012). Initially, it was

defined as "using gaming design elements in non-gaming contexts"; gamification was utilized to describe the use of video-gaming elements - from matches to tokens - to improve the user experience and guiding interaction in non-gaming services and applications (Deterding & et al, 2011).

Despite its relatively short history, the number of management books and webinars devoted to gamification is significant. In fact, organizations are making great efforts to develop efficient gamification practices. Thus, since 2011, rehabilitation research has increased exponentially. Although gamification benefits have been widely acknowledged and proved in commerce; But the academic literature indicates brief results and studies about its benefits (Leclercq & et al, 2020). Studies show that gamification is a precious method to improve learning outcomes, increase user motivation, influence user behavior, and is also an exciting entertainment (Eisingerich & et al, 2019). Therefore, gaming design improves the non-gaming environment to promote products or services by creating more enjoyable software programs for users and atmosphere of motivation, attraction, and influence to utilize the product or services designed in a gamification mode (Baptista & Oliveira, 2019).

Walsh (2009) indicates that if websites lack gamification features, youngsters will not pay enough attention to them. Hence, it makes one think that the game features have powerful impacts on human behavior, and the invention of the games has been an important leap to pursue the motivation of users. Thus, the evolution of computer software and also game features, have devoted a path to a specific process of gaming development.

This new paradigm relates to the concepts that cause human and machine interaction, creating persuasion, eye-catching design, and game mechanism (Rodrigues & et al, 2019). Therefore, gamification is a new way of thinking, developing, designing and using information systems and software applications intending to change the attitude and behavior of users (Konstantakopoulos & et al, 2019).

Deterding et al. (2011) classify gamification elements as network designing, monitoring, interactions, signs, goals or objectives, leadership, competition, motivation, rewards, rules, interface, and roles. Gamification involves adding a layer of "game" to e-campaigns such as e-learning, e-business, e-commerce and e-health. For example, it allows users to change tasks, train, or encourage change in attitudes and human behavior. In general, in games, people are often committed and continue to work with high intrinsic motivation and can achieve cognitive, emotional and social benefits (Hamari & Keronen, 2017, Vesa & et al, 2017). This concept has several programs in the field of career development and learning. Recent studies, however, have concentrated on the use of gamification in education to develop and expand the learning process.

Studies show that the use of games in the learning-based learning process significantly increases the motivation of learners.

Gamification allows learners to participate in challenging tasks and missions and achieve their goals in a short period of time. In addition, games allow the users to repeat a specific task which is unsuccessful. The repetition in failure helps learners/users analyze their previous mistakes, correct them, and finally achieve their desired goals. This creates a positive attitude towards

learning that encourages learners to acquire skills by acknowledging temporary negative experiences for ultimate success. Gamification Is a new trend in applying game mechanisms in non-game fields to motivate participants and create entertainment in daily activities; In addition, it emphasizes creating advantage and motivation (Sardi & et al, 2017). Gamification has become one of the most prominent technological developments in human incentive. Therefore, it is not surprising to utilize gamification in education as one of the most challenging issues in maintaining interaction, motivation and continuity (Koivisto & Hamari, 2019). Digitalization of learning atmospheres and the use of empirical examples have been made possible through technological developments. Due to the long history of using games in learning and teaching, different approaches have been created, including serious games, game-based learning and online games (Majuri & et al, 2018).

Gamification encourages users to explore new areas beyond interests. Researches show that games have several potential benefits, including instant feedback, efficient learning, self-regulated and purposeful learning, and increased teamwork in teaching and learning. In order to create gamification systems in the field of education, this fact should be noted that focusing on mechanisms considered by learners is one of the primary and essential factors of the game (Baydas & Cicek, 2019). The research in gamification indicates that most of the experimental research has been done on its application in the education and learning field (Rodrigues & et al, 2019). The use of gaming concepts in education makes it possible to continue the teaching process using attractive and new methods based on group and complementary activities, instead of following the teaching methods in dry and boring classrooms. The benefit of gaming concept in education is its entertaining element, simplicity, comprehensibility and no limitation of time, place and person (Sanchez & et al, 2020). Researches indicate that the gamification structures used for teaching utilize a classification system ranking learners in ascending order. Although rewards increase competition, interest and motivation among learners; however, it can also have negative consequences. Therefore, goals, types of feedback, and rewards need to be clearly clarified, and learners get involved in a positive, individual flow that involves learning. The permanent awareness of learners of the game process and progress will lead to their satisfaction and learning progress (Davis, 1989). Due to the popularity of gamification systems, the utilization of these systems is expanding daily. According to the study's topic, some of the studies conducted in this field are mentioned below. Konstantakopoulos et al. (2019) in a study entitled " A deep learning and gamification approach to improving human-building interaction and energy efficiency in smart infrastructure ", implied that the deep learning structure provided by gamification software through continuous information flow has an impact on improving overall optimal consumption and the reduction of energy consumption. The utilization of gamification software showed that intelligent infrastructure provides substantial opportunities to improve energy efficiency and smart network management (Konstantakopoulos & et al, 2019). Rodrigues et al. (2019) in a study entitled "Main gamification concepts: A systematic mapping study" indicated that innovation in education could help students improve learning

and understanding of different concepts and lead to better and more desirable results. The study's statistical population comprises students in a bachelor's degree in a chemical engineering discipline at the Technical University of Madrid. Various methods are integrated and used in this course: classroom, peer education and gamification. To implement the mentioned methods, the following tools have been prepared in addition to traditional materials such as slides and textbooks: screens, concept tests and simulations. The results indicate students' high motivation and more participation in the class and better results (grades) in the subjects. In this approach, different innovation experiences are used in education. The utilized method is not only based on a single method but also, several different methods have been utilized and integrated. The results showed more motivation and more interest in the subject. Classes were more dynamic, and students' participation was much higher and also leading to learning increase (Rodrigues & et al, 2019). Sanchez et al. (2019) in their research reached a conclusion implying that gamification tests revealed a great impact on learners' learning, although it may not be permanent. The findings also showed that learners who used gamification tests could successfully achieve higher accomplishments (Sanchez & et al, 2020). Maccavi indicates that in 2019, efforts to maintain and improve online education quality led to the redesign of nurses' training courses. Therefore, a gamification-based online education management system was designed. Elements of the game include voluntary participation with immediate feedback that can lead to positive and negative social relationships. The research findings also showed that students' scores increased significantly. Although there are many ways to learn online, using a gamification-based approach reflecting different social and cultural situations to challenge the learners. Toda et al. (2019) investigated a study entitled "An approach for planning and utilizing gamification concepts using social networks in learning-related scopes" indicating that applying gamification in the field of education can lead to better learning. Also, the gamification strategy has had an acceptable and positive acceptance among students and teachers. Students also reported that their access to group study through social media has increased in their gamification experience, leading to increased socializing with their peers to learn more.

Sanchez et al. (2020) in a study concluded that gamification tests greatly impact learners' learning, But the effects may not be permanent. Their findings also showed that learners who used gamification tests, achieving higher accomplishments. Koivisto (2019) indicated that gamification is a phenomenon derived from information technology/information system; at its core, the use of recreational / entertainment information systems and their design in various information systems are advantageous. However, little attention has been paid to the concept of information technology indicating the need for research in other fields and specifically, the fields of education and human interaction with computers. Baptista & Oliveira (2019) consider some factors as significant ones including ease of use criteria, learning opportunities, enjoyment, sociability, intent to use, aesthetic value, attitude, utility, branding and recognition are important for the implementation of the gamification

systems. Hakak et al. (2019) signify some elements including criteria for short-term tasks, reward system, motivation, game identification, and proper task design. The following is a table (1) of the effective driver for using gamification in information systems.

Table 1. Driver affecting gamification extracted from former studies

Driver	Number	Driver	Number
Enjoying	1	Ease of use	16
Short-Term Tasks	2	Learning opportunities	17
Reward-System	3	Design Cost	18
Signs	4	Sociability	19
Intention	5	Being Challenging	20
Perspective	6	Beauty Value	21
Game Identification	7	Incentive	22
Proper design of the game	8	Usefulness	23
Brand orientation	9	Narrativeness	24
Customization	10	Avatar	25
Scoreboard	11	Cryptocurencyy	26
Competitiveness	12	Career Ladder	27
Recognition	13	Cooperation	28
Supervisory	14	Network Design	29
Regulations	15	Leadership	30

Research Methodology

The methodology of this study is applied in terms of purpose and descriptive-survey in terms of data collection. Its statistical population includes faculty members of the Persian Gulf University. Sample members were selected by purposeful non-random sampling method based on experimental and theoretical knowledge in the field. Necessary data in this study were collected with a researcher-made questionnaire. The thematic analysis method was used to determine the validity of research questionnaires. Thus, the designed questionnaire was given to 14 research experts whom were asked to express their opinion about the validity. The collection of comments indicated the validity of the questionnaires. To measure the reliability of the questionnaire, the incompatibility rate index was used. Figure (1) Shows the design steps for a soft model of gamification driver.

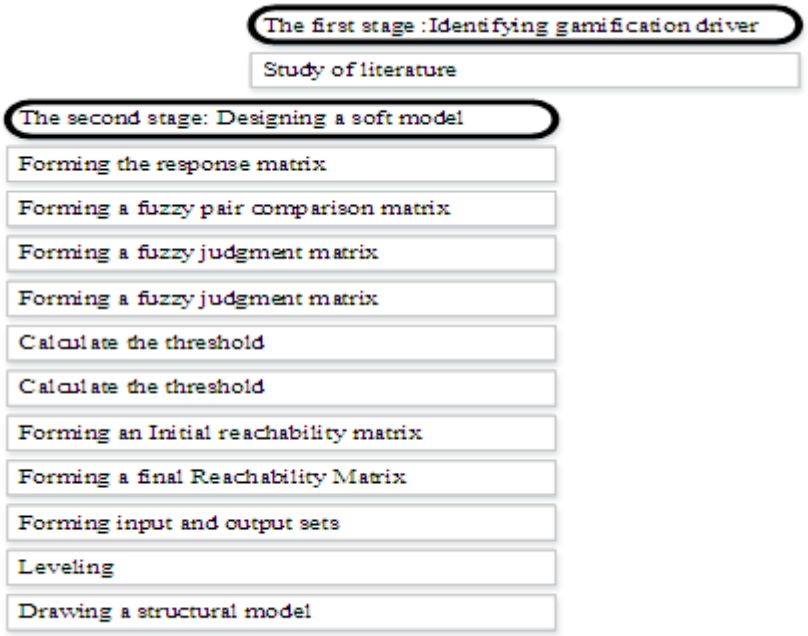

Figure 1. Steps of Soft Modelling of Gamification driver

Turning to the steps of the above figure, this research has been done in two phases:

Step 1) Identifying gamification driver

In this study, thirty gamification driver were extracted using previous studies. Then, using experts' opinions, this number of driver was adjusted to 11 main driver of the game in learning management systems. Then, using the opinions of experts, this number of driver was adjusted to 11 main gamification driver in the learning management system of Persian Gulf University.

Step 2) Fuzzy interpretive structural modelling approach

Interpretive structural modelling is an approach to structuring and graphically restating complex problems. This approach was first proposed by Warfield in 1973 and analyzed the interrelationships between variables (Ghorbanpour & et al, 2016). In the classical case, this approach discusses the existence or non-existence of a relationship between variables and does not analyze their intensity. In the fuzzy interpretive structural modelling approach, in order to collect the views of the respondents, a researcher-made questionnaire with the fuzzy spectrum of table (2) is utilized.

Table 2. Language spectrum and fuzzy triangular numbers (Tseng, 2013)

Symbol	Language variable	Fuzzy Numbers
NO	Effectless	(0, 0, 0.25)
L	Low impact	(0, 0.25, 0.5)
M	Medium Impact	(0.25, 0.5, 0.75)
H	High Impact	(0.5, 0.75, 1)
VH	Very High Impact	(0.75, 1, 1)

Then, by collecting the questionnaires, the answer matrix is created. Next, by converting its symbols to fuzzy numbers according to the table

above, a matrix of fuzzy pairwise comparisons were formed. Equation (1) represents the general form of this matrix

$$D = [\tilde{d}_{ij}] \qquad \text{Equation 1}$$

In the above relation, D and $\tilde{d}_{ij}$ represent the matrix of fuzzy pairwise comparisons, and fuzzy number are equivalent to the experts' response for factor ij.

$$IR = \frac{1}{n(n-1)} \sum_{i=1}^{n} \sum_{j=1}^{n} \left| \cdot \right| \qquad \text{Equation 2}$$

100%

In the above relation, IR ,n,t_{ij}^{r} represent the incompatibility rate, the number of criteria, and the average score of the r-person to the i-th criterion relative to the j-th criterion for $1 \leq i \leq n$ and $1 \leq j \leq n$. Calculation of incompatibility rate less than 0.05 indicates confirmation of compatibility of response matrices (Jeng, 2015).

Next, the fuzzy judgment matrix is formed with the geometric mean of experts' opinions. Equation (3) shows this matrix:

$$G = [\tilde{g}_{ij}] \qquad \text{Equation 3}$$

In the above relation, G and $\tilde{g}_{ij}$ represents the fuzzy judgment matrix and the combined number of expert opinions for the ij driver, respectively. Then, the normalization matrix is calculated through equation (4) (Ghorbanpour & et al, 2016).

$$N = \frac{G}{\gamma = \max\limits_{1 \leq i \leq n} \sum_{j=1}^{n} u_{ij}} \qquad \text{Equation 4}$$

In the above relation, u_{ij} represents the upper limit of the fuzzy numbers of the judgment matrix. In order for the defuzzification of fuzzy numbers, the best non-fuzzy performance method, according to Equation (5) has been used (Xiong & et al, 2010).

$$BNP_{ij} = \frac{u_{ij} - l_{ij} + m_{ij} - l_{ij}}{3} + l_{ij} \qquad \text{Equation 5}$$

Then, the threshold was obtained by calculating the arithmetic average of the defuzzy matrix values using relation (6). Next, the incidence matrix is formed by comparing each array of the defuzzy matrix with the threshold (Jeng, 2015). Then, the Initial Reachability Matrix was accomplished using the sum of neighboring matrix. Then, the final reachability matrix is obtained by including portability and equation (6) (Ghorbanpour & et al, 2016).

$$M^{*} = M^{k} = M^{K+1} \quad . \; k > 1 \qquad \text{Equation 6}$$

In the above relation, $M^{*}$and k represent the final reachability matrix and a number, respectively. In the next step, the input sets that include the element itself and the influential elements are created out of it, and also the output that includes the element itself and the influential and common elements are created. Elements in which the output and standard sets are precisely the same are positioned at the highest hierarchy level. Then, by removing the levelled elements and repeating the above operations, an interpretive structural model is designed. Then, by removing the portability, the final model is

accomplished (Ghorbanpour & et al, 2016).

Research Findings

As mentioned earlier, the initial phase of this study was the identification of driver. By examining the theoretical foundations and empirical background, 30 effective drivers in the learning/teaching systems gamification have been identified. Finally, eleven main drivers were identified in the Table (3).

Table 3. Final list of Gamification driver

The Definition of each driver	Symbol	driver
The overall assessment of users regarding the use of systems is favorable or unfavorable	C_1	Incentive
Difficult planning of some tasks may cause anxiety and slow down the learning process. Therefore, it should flow in the design of small works that do not require tedious effort. Work design should be balanced in terms of work done.	C_2	Proper design
Actors' perception and orientation of the components of the game and its recognition as something serious	C_3	Recognition
The degree to which a person is confident in using an information system will need no special effort it includes ease of use	C_4	Ease of Use
Cooperation by introducing teams, that is, creating specific groups of players who work together to achieve a shared goal	C_5	Cooperation
Customization is defined as activities in which users themselves modify certain aspects of the interface to increase its personal relevance	C_6	Customization
Motivation is an essential element that should be considered when designing a gamification for educational purposes. Emotional calculations can help improve motivation in designing emotion-based mediators.	C_7	Incentive
Users' perception of entertainment, fun and excitement	C_8	Beauty Value
The degree to which a person is confident that the use of an information system can provide him or her with learning opportunities	C_9	Learning Opportunity
Avatars are visual representations of players within the game atmosphere or gamification atmosphere that are selected or even created by the player	C_{10}	Avatar
Performance charts are often used in simulation or strategy games and provide information about players' performance compared to their previous performance during the game.	C_{11}	Career Ladder

In the second phase, the model design is done with a fuzzy interpretive structural modelling approach. First, a researcher-made questionnaire was designed using the calculated driver. The validity of this questionnaire was confirmed by face content analysis method. The incompatibility rate was calculated compared to equation 2 which was 0.041 which indicates the questionnaire's validity. Then, to receive the experts' perspectives, a questionnaire was distributed and collected in person among 14 research experts. In this questionnaire, drivers are compared in pairs based on the table's spectrum (2). Next, a response matrix was formed for each expert. Table (4) shows the first expert response matrix.

Table 4. Response matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}
C_1		H	L	M	H	L	M	M	M	VH	M
C_2	M		M	L	L	L	L	L	L	M	L
C_3	M	NO		NO	L	NO	L	M	L	VH	L
C_4	L	L	NO		L	L	L3	L	M	VH	L
C_5	L	M	M	M		M	M	L	M	L	M
C_6	M	NO	H	H	M		L	NO	L	NO	L
C_7	M	L	H	H	L	M		L	M	M	M
C_9	L	L	M	M	L	L	NO		L	NO	NO
C_9	NO	L	M	M	L	NO	M	H		M	M
C_{10}	L	L	L	L	L	L	L	H	L		M
C_{11}	L	M	VH	L	L	L	L	M	L	L	

Reference: Research Findings

The pairwise comparisons matrix was then formed for each of the experts by converting the response symbols to fuzzy numbers. Table (5) shows the fuzzy pairwise comparison matrix for the first expert.

Table 5. Fuzzy Pairwise Comparison Matrix

	C_1			C_2			C_3			C_4			C_5			C_6			C_7			C_8			C_9			C_{10}			C_{11}		
C_1	0	0	0	0.5	0.75	1	0	0.25	0.5	0.25	0.5	0.75	0.5	0.75	1	0	0.25	0.5	0.25	0.5	0.8	0.25	0.5	0.75	0.25	0.5	0.75	0.75	1	1	0.25	0.5	0.75
C_2	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0.25	0.5	0.75	0	0.25	0.5
C_3	0.25	0.5	0.75	0	0	0.25	0	0	0	0	0	0.25	0	0.25	0.5	0	0	0.25	0	0.25	0.5	0.25	0.5	0.75	0	0.25	0.5	0.75	1	1	0	0.25	0.5
C_4	0	0.25	0.5	0	0.25	0.5	0	0	0.25	0	0	0	0	0.25	0.5	0	0.25	0.5	0.25	0.5	0.8	0	0.25	0.5	0.25	0.5	0.75	0.75	1	1	0	0.25	0.5
C_5	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75	0	0	0	0.25	0.5	0.75	0.25	0.5	0.8	0	0.25	0.5	0.25	0.5	0.75	0	0.25	0.5	0.25	0.5	0.75
C_6	0.25	0.5	0.75	0	0	0.25	0.5	0.75	1	0.5	0.75	1	0.25	0.5	0.75	0	0	0	0	0.25	0.5	0	0	0.25	0	0.25	0.5	0	0	0.25	0	0.25	0.5
C_7	0.25	0.5	0.75	0	0.25	0.5	0.5	0.75	1	0.5	0.75	1	0	0.25	0.5	0.25	0.5	0.75	0	0	0	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
C_9	0	0.25	0.5	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75	0	0.25	0.5	0	0.25	0.5	0	0	0.3	0	0	0	0	0.25	0.5	0	0	0.25	0	0	0.25
C_9	0	0	0.25	0	0.25	0.5	0.25	0.5	0.75	0.25	0.5	0.75	0.5	0.75	1	0.75	1	1	0.25	0.5	0.8	0.5	0.75	1	0	0	0	0.25	0.5	0.75	0.25	0.5	0.75
C_{10}	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0	0.25	0	0.25	0.5	0	0.25	0.5	0.5	0.75	1	0	0.25	0.5	0	0	0	0.25	0.5	0.75
C_{11}	0	0.25	0.5	0.25	0.5	0.75	0.75	1	1	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0	0.25	0.5	0.25	0.5	0.75	0	0.25	0.5	0.25	0.5	0.75	0	0	0

Then, with the geometric mean of the fuzzy pairwise comparison matrix, the fuzzy judgment matrix was calculated in table (6).

Table 6. Fuzzy Judgment Matrix

	C_1			C_2			C_3			C_4			C_5			C_6			C_7			C_8			C_9			C_{10}			C_{11}		
C_1	0	0	0	0	0	0.51	0	0	0.52	0	0.513	0	0.523	0	0	0.426	0	0	0.462	0.389	0.659	0.848	0	0.494	0	0.519	0	0	0.478
C_2	0	0	0.52	0	0	0	0	0	0.82	0	0.500	0	0.405	0	0	0.431	0	0.476	0.693	0	0	0.474	0	0.447	0	0.502	0	0	0.480
C_3	0	0	0.50	0	0	0.52	0	0	0	0	0.515	0	0.431	0	0	0.494	0	0	0.444	0	0	0.523	0	0.494	0	0.530	0	0	0.494
C_4	0	0.515	0.73	0	0	0.53	0	0	0.37	0	0	0	0.651	0	0	0.530	0	0	0.834	0	0	0.530	0	0.494	0	0.502	0	0.438	0.704
C_5	0	0.431	0.66	0	0	0.52	0	0	0.52	0	0.400	0	·	0	0.55	0.768	0	0	0.508	0	0	0.444	0	0.470	0	0.583	0	0	0.502
C_6	0	0	0.53	0	0	0.50	0	0	0.66	0	0.519	0	0.534	0	0	0.000	0	0	0.530	0	0	0.500	0	0.494	0	0.515	0	0.414	0.676
C_7	0	0	0.51	0	0.49	0.71	0.41	0.68	0.90	0	0.646	0	0.523	0	0	0.662	0	0	0	0	0	0.523	0	0.532	0	0.722	0	0	0.539
C_9	0	0	0.54	0	0	0.50	0	0	0.41	0	0.523	0	0.410	0	0	0.545	0	0	0.533	0	0	0	0	0.490	0	0.457	0	0	0.466
C_9	0	0	0.41	0	0.615	0.80	0	0	0.52	0	0.519	0	0.852	0	0	0.530	0	0	0.753	0	0	0.515	0	0	0	0.478	0	0	0.513
C_{10}	0	0	0.50	0	0	0.52	0	0	0.48	0	0.484	0	0.330	0	0	0.498	0	0	0.519	0	0	0.690	0	0.534	0	·	0	0	0.502
C_{11}	0	0	0.51	0	0	0.50	0	0	0.52	0	0.508	0	0.534	0	0	0.508	0	0	0.320	0	0	0.504	0	0.534	0	0.528	0	0	0

Then, using equation (4), the normalized matrix is calculated from the fuzzy judgment matrix in the form of Table (7).

Table 7. Fuzzy normalized matrix

	C_1			C_2			C_3			C_4			C_5			C_6			C_7			C_8			C_9			C_{10}			C_{11}		
C_1	0	0	0	0	0	0.081	0	0	0.083	0	0	0.082	0	0	0.083	0	0	0.068	0	0	0.074	0.062	0.105	0.135	0	0	0.079	0	0	0.083	0	0	0.076
C_2	0	0	0.083	0	0	0	0	0	0.13	0	0	0.08	0	0	0.065	0	0	0.069	0	0.076	0.11	0	0	0.076	0	0	0.071	0	0	0.08	0	0	0.076
C_3	0	0	0.08	0	0	0.082	0	0	0	0	0	0.082	0	0	0.069	0	0	0.079	0	0	0.071	0	0	0.083	0	0	0.079	0	0	0.084	0	0	0.079
C_4	0	0.082	0.117	0	0	0.084	0	0	0.058	0	0		0	0	0.104	0	0	0.084	0	0	0.132	0	0	0.084	0	0	0.079	0	0	0.08	0	0.07	0.112
C_5	0	0.069	0.106	0	0	0.083	0	0	0.083	0	0	0.064	0	0	0	0	0.088	0.122	0	0	0.081	0	0	0.071	0	0	0.075	0	0	0.093	0	0	0.08
C_6	0	0	0.084	0	0	0.079	0	0	0.106	0	0	0.083	0	0	0.085	0	0	0	0	0	0.084	0	0	0.08	0	0	0.079	0	0	0.082	0	0.066	0.108
C_7	0	0	0.082	0	0.078	0.114	0.066	0.108	0.144	0	0	0.103	0	0	0.083	0	0	0.106	0	0	0	0	0	0.083	0	0	0.085	0	0	0.115	0	0	0.086
C_9	0	0	0.086	0	0	0.079	0	0	0.066	0	0	0.083	0	0	0.065	0	0	0.087	0	0	0.085	0	0	0	0	0	0.078	0	0	0.073	0	0	0.074
C_9	0	0	0.065	0	0.098	0.128	0	0	0.083	0	0	0.083	0	0	0.136	0	0	0.084	0	0	0.12	0	0	0.082	0	0	0	0	0	0.076	0	0	0.082
C_{10}	0	0	0.079	0	0	0.083	0	0	0.077	0	0	0.077	0	0	0.053	0	0	0.079	0	0	0.083	0	0	0.11	0	0	0.085	0	0	0	0	0	0.08
C_{11}	0	0	0.081	0	0	0.08	0	0	0.083	0	0	0.081	0	0	0.085	0	0	0.081	0	0	0.051	0	0	0.08	0	0	0.085	0	0	0.084	0	0	0

Then, using equation (5), the defuzzy matrix was calculated in the form of Table (8).

Table 8. Defuzzy matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}
C_1	0	0.027	0.028	0.027	0.028	0.023	0.025	0.101	0.026	0.028	0.025
C_2	0.028	0	0.043	0.027	0.022	0.023	0.062	0.025	0.024	0.027	0.025
C_3	0.027	0.027	0	0.027	0.023	0.026	0.024	0.028	0.026	0.028	0.026
C_4	0.066	0.028	0.019	0	0.035	0.028	0.044	0.028	0.026	0.027	0.061
C_5	0.058	0.028	0.028	0.021	0	0.07	0.027	0.024	0.025	0.031	0.027
C_6	0.028	0.026	0.035	0.028	0.028	0	0.028	0.027	0.026	0.027	0.058
C_7	0.027	0.064	0.106	0.034	0.028	0.035	0	0.028	0.028	0.038	0.029
C_9	0.029	0.026	0.022	0.028	0.022	0.029	0.028	0	0.026	0.024	0.025
C_9	0.022	0.075	0.028	0.028	0.045	0.028	0.04	0.027	0	0.025	0.027
C_{10}	0.026	0.028	0.026	0.026	0.018	0.026	0.028	0.037	0.028	0	0.027
C_{11}	0.027	0.027	0.028	0.027	0.028	0.027	0.017	0.027	0.028	0.028	0

Then, by calculating the threshold to a value equal to 0.0286, the initial reachability matrix was obtained in the form of Table (9).

Table 9. Initial reachability matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}
C_1	1	0	0	0	0	0	0	1	0	0	0
C_2	0	1	1	0	0	0	1	0	0	0	0
C_3	0	0	1	0	0	0	0	0	0	0	0
C_4	1	0	0	1	1	0	1	0	0	0	1
C_5	1	0	0	0	1	1	0	0	0	1	0
C_6	0	0	1	0	0	1	0	0	0	0	1
C_7	0	1	1	1	0	1	1	0	0	1	0
C_9	0	0	0	0	0	1	0	1	0	0	0
C_9	0	1	0	0	1	0	1	0	1	0	0
C_{10}	0	0	0	0	0	0	0	1	0	1	0
C_{11}	0	0	0	0	0	0	0	0	0	0	1

Then, using equation (6), the final reachability matrix in Table (11) was obtained.

Table 11. Final Reachability Matrix

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}
C_1	1	0	1	0	0	1	0	1	0	0	1
C_2	1	1	1	1	1	1	1	1	0	1	1
C_3	0	0	1	0	0	0	0	0	0	0	0

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}
C_4	1	1	1	1	1	1	1	1	0	1	1
C_5	1	0	1	0	1	1	0	1	0	1	1
C_6	0	0	1	0	0	1	0	0	0	0	1
C_7	1	1	1	1	1	1	1	1	0	1	1
C_8	0	0	1	0	0	1	0	1	0	0	1
C_9	1	1	1	1	1	1	1	1	1	1	1
C_{10}	0	0	1	0	0	1	0	1	0	1	1
C_{11}	0	0	0	0	0	0	0	0	0	0	1

Then, the output/input and common sets of each of the gamification driver in the learning management system were obtained, which resulted in the levelling of the driver. Table (12) shows a summary of 1 to 7 repetitions of driver levelling.

Table 12. Summary of repetitions of gamification driver leveling

Level	Shared	Input	Output	driver	Repetition
1	3	10, 9, 8, 7, 6, 5, 4, 3, 2, 1	3	3	1
	11	11, 10, 9, 8, 7, 6, 5, 4, 2, 1	11	11	
2	6	10, 9, 8, 7, 6, 5, 4, 2, 1	6	6	2
3	8	10, 9, 7, 5, 4, 2, 1	8	8	3
4	10	10, 9, 7, 5, 4, 2	10	10	4
	1	9, 7, 5, 4, 2, 1	1	1	
5	5	9, 7, 5, 4, 2	5	5	5
6	7, 4, 2	9, 7, 4, 2	7, 4, 2	2	6
	7, 4, 2	9, 7, 4, 2	7, 4, 2	7	
	7, 4, 2	9, 7, 4, 2	7, 4, 2	4	
7	9	9	9	9	7

Finally, the final model of the fuzzy interpretive structure is drawn by removing the portability. Figure (2) shows the structuring of gamification driver in learning management systems.

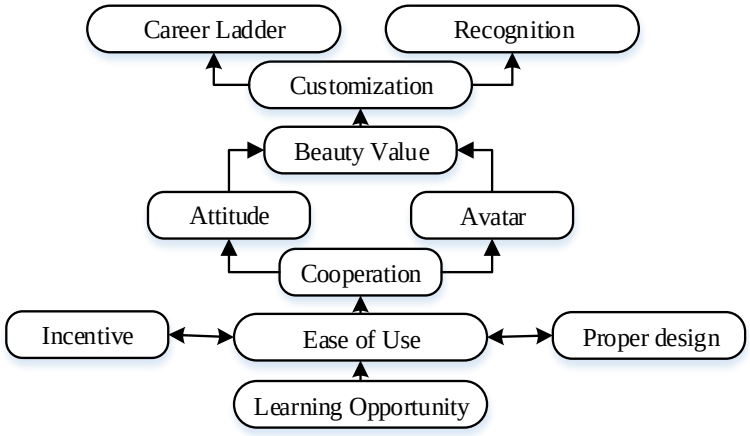

Figure 2. Soft model of gamification driver in learning management systems

As the figure above shows, the driver of "learning opportunities", "proper design", "ease of use" and "incentive" were at the roots of the model.

Conclusions and Suggestions

In the last few decades, the dominant discourse of active learning has been motivational in the learning process. Gamification is considered as one of the most prominent technological advances in this field that its integration in the method of virtual education which is widely used due to the emergence of the Covid-19 pandemic could substantially increase the empowerment of this type of education encouraging the nations' universities to be utilizing it in the academic and learning atmospheres. This study's main purpose is to identify gamification driver in learning management systems and their soft structuring in the uncertainty conditions. First, eleven drivers were identified by studying the theoretical foundations and empirical background and content analysis approach.

The statistical population of this research consists of university faculty members of Persian Gulf University with proper experimental and theoretical knowledge in information systems. Fourteen of them were selected as sample members by purposeful judgmental sampling method. The data collection tool is a researcher-made questionnaire. To determine the validity of the research questionnaires, face content analysis method was used. The designed questionnaires were given to five research experts, and each of them was asked to express their opinion about the validity. The collection of comments showed the validity of the questionnaires. To measure the reliability of the questionnaire, the incompatibility rate index was used. Calculation of the value of 0.041 for this index indicates the confirmation of the reliability of this questionnaire.

Then, the fuzzy interpretive structural modelling approach was used to structure gamification driver in learning/teaching systems to manage language ambiguities in judgments. Findings showed that the driver of "learning opportunity", "proper design", "ease of use" and "incentive" were at the lower level of the model and are introduced as the main and root driver. A review of previous literature also confirms the results of this study. Oliver and Hakan (2018), in a study, showed that the factors of "ease of use" and "learning opportunities" have the most significant role in the gamification of all information systems. In another study, Hakak et al. (2019) point out that incentive is the most important capability influencing gamification information systems.

It should be noted that this research is the first phase to help future researches. Therefore, researchers are advised to apply this emerging concept of information systems by conducting studies from different aspects. This study has only structured gamification driver. Researchers can use other approaches to evaluate the importance of obtained driver. Implementing the root driver of the model of this study will undoubtedly bring many obstacles and contradictions. Therefore, identifying barriers and improvement strategies can be the subject of other researches. It is also suggested that the purpose of this research be analyzed through other methods of soft operations to compare the results.

This study tried to provide insights and understanding to managers in this social class by identifying gamification driver in learning management systems in order to have a better understanding of the system to increase the level of user motivation and learning improvement.

One of the limitations of this study can be considered in the localization of driver. Because, in this research, experts are assumed to be equal in terms of knowledge. As mentioned earlier, gamification in learning/teaching systems is a new discourse. Therefore, there may be a knowledge gap between experts, which will lead to the results. Finally, despite accurate scientific calculations and analysis in designing and analyzing the model to observe scientific literature, deliberation on generalizing the results is suggested.

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