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AN EXPERIMENTAL STUDY: PERSONALIZED GAMIFED LEARNING BASED ON LEARNING STYLE

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ABSTRACT

Numerous game related elements such as points, badges, leaderboard, and ranking are utilized in educational context when motivation and engagement need to be boosted. Undoubtedly, influencing students' engagement has been reported as one of the gamification's pros. However, study the effects of certain game elements on dissimilar types of students is recommended by several researchers. Accordingly, a learning style is a vital factor in human learning process which is considered as an important personalization parameter in several eLearning tools. This research has used Felder-Silverman Learning Style Model (FSLSM) as personalization parameter along with 10 game elements to propose a personalized gamified learning model. A Design Science Research Approach (DSRA) has been undertaken to examine the proposed model in improving the students' scores in Data Flow Diagram (DFD) lesson during class learning process. For validating the proposed model, 50 Multiple Choice Questions for DFD web-based gamified application has been developed. An experimental study using the application has been conducted with 71 undergraduate students from School of Computing, Faculty of Engineering, Universiti Teknologi Malaysia (UTM). Participants were divided into two groups: experimental and control. Additionally, the gamification application has two different modes: personalized mode (for experimental group) and non-personalized mode (for control group). Data was collected from the application database and perceived usefulness questionnaire. An independent t-test has been used to compare means of scores between the groups. Result shows that personalized gamified learning is an effective method in learning process, as well as in boosting student perceived usefulness of the application.

Keywords: *Gamification, Learning Style, Personalized Learning*

1. INTRODUCTION

Conceptually, gamification is defined as utilizing one or multiple game elements such as points, badges, leaderboard, and progress bar in a non-game context. Currently, there is a growing number of research works in exploring the effectiveness of utilizing gamification in certain areas such as health, fitness, and marketing [1, 2]. In that vein, gamification can be used as a tool to expand people's participation and involvement to carry out activities that typically could not be fully attractive. A variety of empirical studies have proven that gamification strategies have boundless opportunities for improving learning outcomes as traditional learning processes and technologies are no longer as engaging students as they were expected [3][4]. Therefore, some educational institutions tend to adopt gamification technology in the classroom and eLearning systems [5].

Despite the potential advantages of gamified learning systems, researchers suggested for more pragmatic investigations on the impact of the game elements on not only student's perception, motivation, engagement but also student's performance and self-efficacy [6]. In addition, they recommended studying the game elements effects according to student's personality and learning style[7][6][8]. The matching between the student's preferences and the appropriate form of instructional intervention lead to acquire personalized learning that is recommended by researchers to boost the effectiveness of the higher education system. Practically, extraordinary characteristics such as being confident, team-

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orientated, goal focused, and socially networked are most popular features of new generations. For example, Millennial Generation or Generation Y students are considered as being the first digital natives [7] because they have been wide-open to Information Technology (IT) from birth. Hence, introducing personalized, motivating, and tailored learning is one of the most challenging issues in the higher education.

Learning style is the way students perceive and process the information to achieve the course learning outcomes. Learning style is one of the human factors that gain a great concern from the researchers in order to introduce personalized learning systems that would improve not only student's experience but also performance and achievement of learning outcomes [7, 9]. Although several learning styles models have been developed, one of the most wide-spread learning styles models that has been utilized in many computer-assisted learning applications is the Felder-Silverman Learning Style (FSLSM) [10].

Thus, this study aims to propose a model based on FSLSM dimensions along with their compatible game elements; then to investigate the impact of the proposed model on undergraduate students' performance using class activity experiment. This paper is constructed into five sections: introducing the research problem is provided in section (1), section (2) deliberates on related works; method that has been carried out in this research is explained in section (3); result and discussion is shown in section (4) and conclusion is presented in section (5). Next subsections discuss the terms gamification, learning style and Felder-Silverman Learning Style Model (FSLSM).

2. RELATED WORK

2.1 Gamification

Clear and highly cited definition of gamification is that "gamification is the use of game design elements in non-game contexts" [11]. Another definition of gamification was coined to describe the approach of using elements typically belong to a game environment in non-game applications [12]. Non-game context refers to any area that is apart from fun or entertainment such as, education, marketing, daily activities, health etc. Researchers have interest in conducting more investigations on gamification aiming for its benefits in each field. Benefits could be involvements, fun, motivation, engagement etc. Therefore, gamification can tackle some issues related to the effectiveness and engagement of eLearning systems.

Game elements can be adaptive to the environment that use gamification. However, researchers have concluded that there is no generally accepted classification of game elements [13, 14]. Furthermore, researchers reported that using numerous game elements does not guarantee that the gamification system is better [15] Instead, while designing or obtaining the game elements, personality traits, needs, behaviors and learning style of the students must be considered, that would lead to customize learning [16].

The appropriate game elements would lead to have significant impact on the learning process. According to [17], authors reported that leaderboard, badges, levels, and points are important game elements that are suitable for employing in higher education. Table 1. shows the examined game elements and their impact from the literature.

2.2 Learning Style

Learning style is individual differences in the learning process i.e. the differences in understanding, evaluating, and processing information [23]. The vital need to capture the learning style of the learners comes from the differences between students' perception for the course material [24]. Meanwhile a student has the higher ability to perceive the information visually, but, has lower ability in verbal contents. Hence, teachers should consider these differences while conveying the course content. Similarly, if the learning contents and tools do not consider the student' s preferences and learning styles, the learning process would be disturbed [23].

In the last decades, researchers proposed a set of theories and models that described the Learning Styles such as Kobl's learning style Inventory (LSI), Myers-Briggs Type-Indicator (MBTI), and Felder Silverman Learning Style (FSLSM). Consequently, researchers have adopted the models in the learning systems. For instance, Massive Open Online Course (MOOC), Virtual Learning Environment (VLE), and eLearning reported a positive impact in employing those models in producing adaptive learning systems.

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In [25], authors reported that Myers-Briggs Type Indicator MBTI) (1978), Kolb (1984), Felder and Silverman (1988), and Herrman (1990) are the most applicable models in eLearning environment. Furthermore, the authors have analyzed the models and selected Felder Silverman Learning Style (FSLSM) as an effective model in many adaptive eLearning systems. In [26], several learning style models were reviewed to choose the best model used in their experiment; consequently, FSLSM has been selected in the study.

2.3 Felder-Silverman Learning Style Model (FSLSM)

Linda Silverman and Richard M. Felder wrote an article to propose the model of the learning style for engineering students in 1988.

Table 1: The impact of the game elements

Articles	Game Elements	Impact
[15], [4], [18]	Badges	Badges is defined as explicit and more sensible kind of progress. It offers the obvious sense of improvement.
		It refers to a physical representation of some accomplishment/achievement of the students in the system.
		Badges positively affected and fostered student engagement.
		Digital badges tend to have an influence on the motivation for learning.
		The community status is provided by badges and indicated the achievement level.
[15], [4], [19], [20]	Leaderboard	A competitive environment among students is provided by leaderboards.
		It can positively influence academic performance.
		Encourage competition, judging other users, getting better in leaderboard will cause self-improvement feeling.
		The leaderboard transmits progress but also provides players with means to compare themselves to others
[15], [4]	Points	Points encourage students to pay attention to the lesson to obtain extra points.
		Momentary feedback and a quick reward for player's progress.
[4], [19]	Progress bar	Makes satisfaction feeling for seeing improvement amount.
		It motivates user to progress more.
		Display the overall progression is achieved by progress bar
[4]	Clear goals	Seeing the direct impact of efforts. Following goals step by step.
[21]	Challenges	Users will remain motivated by providing many challenges in the learning environment.
		Challenges serve the main purpose of structuring course activities into meaningful endeavors
[21], [19]	Levels	Levels indicate the user's progress within the system.
		Levels can give student players a sense of progression.
		levels usually need less effort and quicker to achieve
[21]	Ranking	The main purpose of ranking is to provide a comparison between the users in the system.
[21]	Customization	Customization can promote motivation, engagement, sense of ownership and control over the system.
[22]	Avatar	Avatar symbolizes the user in the virtual world.
		The user identity and activities to others and to the user itself, in general, is presented by avatars

According to [27] the mismatching between the student's perception and the teaching style can lead to unwelcome outcomes. As a result, students became dull and inactive in class. To personalize the eLearning systems, some researchers adopted FSLSM learning style model in

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eLearning systems [28]. [29] stated that FSLSM is one of the most referenced models in studies addressing learning style for different justifications. Firstly, the model produces a simple validated 44-item questionnaire named Index of Learning Styles (ILS) that makes scholars/teachers measure correspondent's learning choices [30], [26]. Secondly, FSLSM model is considered as learning preferences not as fixed characteristics. Lastly, the model was effectively used by several studies.

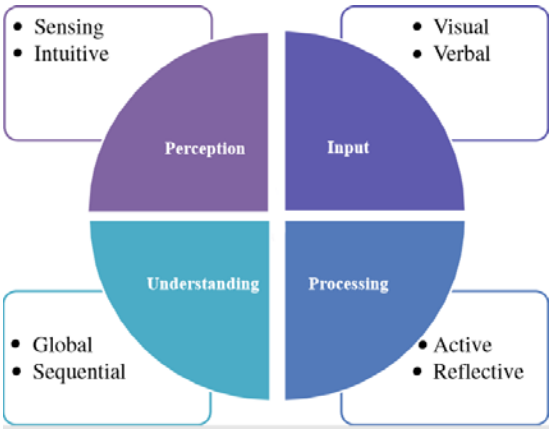

Figure 1: Felder and Silverman Learning Style Model: The model adapted from the modified model by Richard M. Felder and Linda Silverman in June 2002

As it is shown in Figure.1, FSLSM initially had five dimensions depending on how the students perceive and process the information: perception, input, processing and understanding and organization. However, in 2002, the authors have modified the model by adding two significant modifications in the model. The first change was deletion of the organization dimension. The second change was changing the visual/auditory category to visual/verbal. Eventually, the final model has four dimensions. The first dimension is perception which refers to how students perceive the world or the information (see Table.2). This dimension was derived from MBTI model. The second dimension is input and defined as the way people receive information (see Table.3). The third dimension is processing which refers to the process that converts the information into knowledge (see Table.4).

The fourth dimension is understanding which describes the presentation of material with a specific pace (see Table.5). Initially, dimensions' characteristics are needed to be identified that would contribute in identifying and mapping the suitable game elements for each learning style. According to **Error! Reference source not found.**, each dimension presented certain aspects from the personality traits.

Table 2: Sensing / Intuitive Characteristics

Sensing	Intuitive
• Observing and Gathering data through the five senses. • Students relay on actual things surrounding them [4]	• Indirect perception by means, imagination, hunches.
• Facts, data, and experiments are needed to understand new ideas	• Theories are more preferred to explain ideas
• Solving problems with standard methods and no surprises	• Those who are Intuitive believe on open mind and depend on thoughts [4]
• Patient with details	• Welcome Complication
• Good at memorizing facts • Careful but maybe slow	• Quick but maybe careless about a mistake
• Struggling in translating the words	• Comfortable with the symbols or words, so, they like books • Intuitive are creative and do not like repetition

Table 3: Visual /Verbal Characteristics

Visual	Verbal
• Learners prefer pictures, diagrams, flowcharts, timelines, films and demonstrations	• Learners prefer verbal explanation to physical demonstration

Table 4: Active / Reflective Characteristics

Active	Reflective
• In passive condition, active learners do not learn much.	• Without an opportunity to think about an information presented, reflective learners do not learn much
• Team work makes active learners efficient **Error! Reference sourc**	• Reflective students perform better by themselves
• Active students are experimentalists	• Reflective students are theoreticians.

Table 5: Sequential / Global Characteristic

Sequential	Global

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• Students with sequential type, they prefer mastering the material as delivered in a normal progression.	• Global learners sometimes do better by moving to more complex material.
• Linear reasoning processes are adopted by sequential students while solving tasks.	• Global learners make leaps and can explain their solutions.

3. METHODS AND TOOLS

Studying some aspects of gamification or game elements in higher education is quite recent because gamification merely emerges in the education sector [31], [32], [33].

Therefore, it is suggested that using an empirical research approach to produce high-quality, accepted, rigorous, and publishable researches. Design Science Research Methodology (DSRM) has recommended to investigate certain issues in gamification within learning systems [19]. As a result, DSRM has been undertaken in this research. DSRM processes that have been stick to, are described by [34]. Figure.2 illustrated the research methodology framework in this research, and it consists of six phases: problem identification and motivation, defining the objectives of the research, model development, prototype implementation, evaluation, and communication.

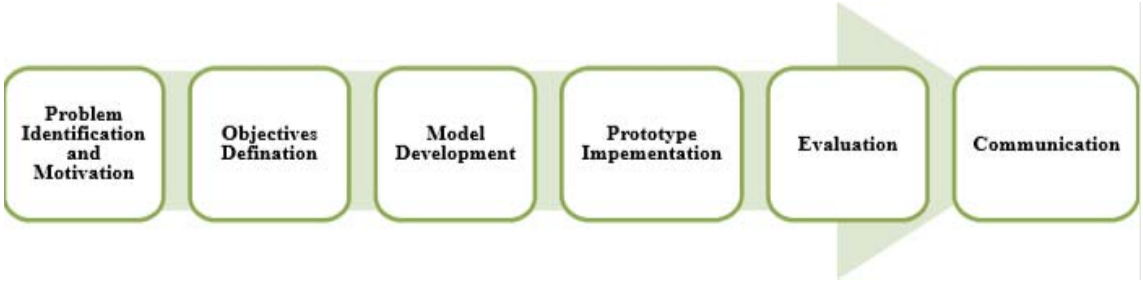

Figure 2: Methodology Framework

3.1 Phase1: Problem identification and motivation

In this phase, researchers have identified the problem using literature review. The review included issues in the gamification, Millennials Generation students, eLearning, and higher education. This helped in identifying and formulating the problem. The problem needs to be tackled is that Millennials Generation students are exposed to the new technologies, so engaging and motivating technology such as gamification should be adopted in higher education to fulfil the student's expectation.

3.2 Phase 2: Research objective definition

Research questions have been developed and the research objectives have been identified. In that vein, the research objectives are: to identify the game elements that suit the student's learning style; to propose a model of personalized gamified learning based on student's learning style and to demonstrate and evaluate the proposed model using an experiment to study the effectiveness of the proposed model.

3.3 Phase 3: Model development

The development activities of the proposed personalized gamified learning model (see Figure.3), have been conducted in this stage. The instrument that was employed to achieve the goal was a literature review including the topics in the study area, and it was mainly based on the conferences and journals articles from online databases Scopus, Springlink, Web of Science, ScienceDirect, and IEEE. As a result of analyzing the learning style characteristics and the common game elements impact, the authors were able to propose the game elements that suit each learning style. The development process consists of three activities: (1) identifying the learning styles model see Figure.1; (2) identify the examined game elements see Table.1 and (3)developing the personalized gamified learning model.

3.3.1 The proposed model

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Figure 3 shows the research proposed model. It contains of 4 dimensions with the suitable game elements. The description of the dimensions is below.

Perception Dimension: The approach which students tend to recognize the world with, is a sensing/ intuitive dimension. For sensing students, data, facts, and experimentation are preferred. Moreover, they prefer to involve observing, gathering data through the senses. Back to game elements and their impacts in Table.1, game elements that are compatible and fulfilled aspects of the dimension are badges, and levels. Badges have a practical and physical evidence of the achievements, so sensing students can perceive and appreciate the achievements more than intuitive learner.

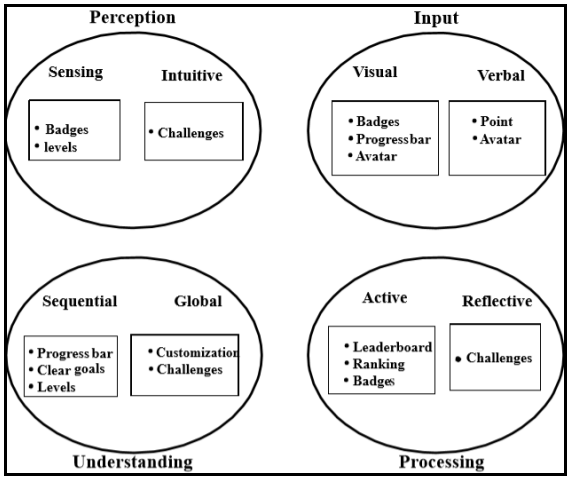

Figure 3: Personalized gamified learning model based on FSLSM

Badges will help them to be eager to achieve more, as a result more achievements will be gained. Levels serve as the well-structured methods that sensing students prefer to follow in order to achieve the course learning goals. Moreover, as sensing students are more patient in details, they will like levels to represent the course in a detailed content. For intuitive students, intuitive students prefer principles and theories and use indirect perception by way of the speculation and imagination. Therefore, challenges will be compatible and suitable game element for intuitive students. Moreover, challenges will provide the engagement as intuitive students are more creative and innovative than sensing students.

Input Dimension: Visual/Verbal dimension refers to the ways people receive information. For visual learners, they remember best based on what they see such as pictures, diagrams, flow charts, timelines, films and demonstrations. Therefore, the game elements that have visual representation can give them better engagement in the learning process. Badge is one of the visual presentations that will motivate students to collect many of them. Moreover, progress bar is used to display the progression visually so the visual students will be motivated to see their progression. For the verbal learners, verbal learners prefer presented information in words and symbols that can be textual presentation. Therefore, point game element is a number representing the achievements by accumulating points from the learning environment. Points can help verbal students to stay motivated during the learning process because of its symbolic appearance. Avatar is the identity symbolization of the students. So, visual and verbal students need to have avatar that will represent them in the learning environment.

Processing Dimension: Active/Reflective dimension is denoted as the complex mental processes by which perceived information is converted into knowledge. Active learners like to involve doing something in the external world with the information. For active learners, badges, leaderboard, and ranking are the most appropriate game elements combination. badges, ranking, and leaderboard are the game elements which gives the sense of competition. The learning process achieved by using rivals of classmates. This learning process will be much more fun and interesting were they will really try their best to compete between each other. Moreover, they can encourage the competition and judging other users that would make the active learners more engaged and comfortable. However, reflective learners like to involve examining and manipulating the information introspectively. Reflective students would be more comfortable with challenges as they will think on how to tackle the challenge regardless of any other than social activities.

Understanding Dimension: Sequential/ Global dimension refers to the logically ordered progression. Sequential learners follow linear reasoning processes when solving problems. In addition, sequential learners can work with material when they understand it partially or superficially. The game elements that could match with sequential learners are those which can show them

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their step by step progression such as progress bar, levels, and clear goals. To start with progress bar, progress bar promotes the satisfaction feeling for sequential students as they can track their improvement easily. With respect to levels, levels also indicate the user's progress within the system that would be welcomed from students in sequential type. Levels have several types such as levels of difficulty and complexity [21]. Sequential learners learn best when material is presented in a steady progression of complexity and difficulty. By having the clear goals of the course, the students would be able to measure their progression based on those goals. However, global students make intuitive leaps and may be unable to explain how they came up with solutions. Therefore, global learners sometimes do better by jumping directly to more complex and difficult material. To fulfil the global student's preferences, customization and challenges are the most effective elements that could engage this type of preferences. As customization gives the impression that students can choose which level they can start with. In addition, students could understand the contents without any consideration of the progression of the content.

3.4 Phase 4: Prototype implementation

The prototype implementation of the proposed model was held during this step. This phase has several activities: to develop the personalized gamified prototype, determining the gamified topic and developing the prototype of online personalized gamified learning tool. Next subsections deliberated the activities within this phase.

3.4.1 Gamified Data Flow Diagram (DFD)

Undergraduate students need to study System Analysis and Design course with code of SCSD2613 as a part of the program requirement. Therefore, Data Flow Diagram (DFD) topic was selected to be gamified. The course deals with planning the development of information systems through understanding and specifying in detail, system components, system analysis, and system design. DFD refers to graphical representation of the "flow" of data through an information system, modelling its process aspects

3.4.2 Developing the online prototype

The developing process of the online personalized gamified learning tool was carried out in this activity. A website developing tools have been used to create the online system on that participants can easily use and interact. The system was designed as a test-based questions, so 50 Multiple Choice Questions related to DFD topic were added to the system see Appendix B. The system allows registered students to answer the questions normally and interact to see their progress using the game elements. The system has two different modes see Figure.4. The first mode is the personalized gamified mode. The second mode is the non-personalized gamified learning prototype. The experimental participants used personalized gamified mode. In the other side, the control participants used non-personalized. In the personalized mode, game-elements were sorted based on the description of the proposed model see Figure.3. Examples of the personalized mode interfaces see Figure.7, Figure.8 and Figure.9. However, in control group, all learning types have all 10 game elements explained in Table.1 in the non-personalized mode without considering the differences in the learning styles.

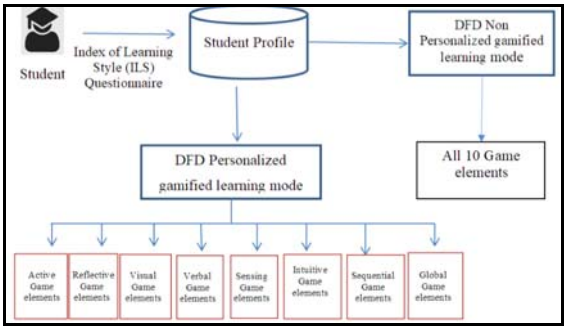

Figure 4: Prototype Structure

To complete the learning mission, students should answer the questions based on the prior information and practical lectures they already studied two weeks ago. Therefore, after students had authentic login by given username and password, they can interact with the system see Figure.5. Figure.6 illustrated the ILS questionnaire interface with the four dimensions in Felder-Silverman learning style where the students need to fill it up see Appendix A. Accordingly, the ILS questionnaire data was stored in the student's profile database.

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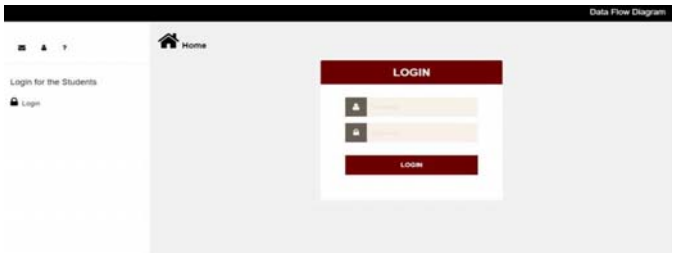

Figure 5: login Interface

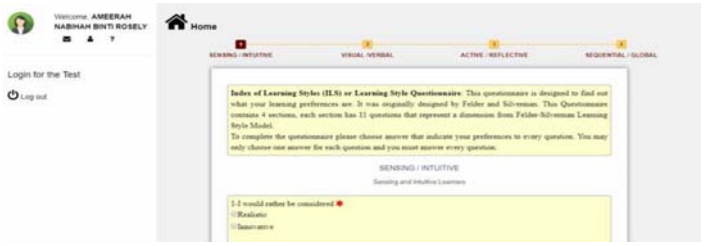

Figure 6: Index of Learning Style (ILS) Questionnaire interface

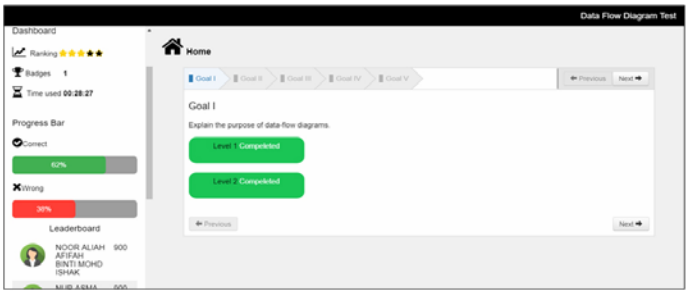

Figure 7: An illustrative dashboard interface example of Active-Visual-Sensing-Sequential learning style preferences in the in the experimental group

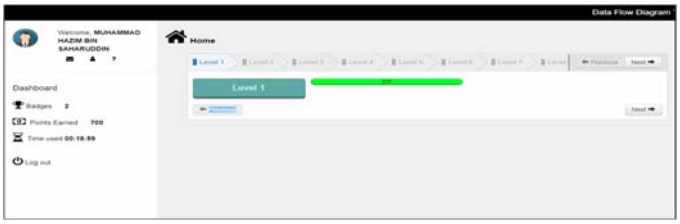

Figure 8: An illustrative dashboard interface example of Active-Visual-Sensing-Sequential learning style preferences in the in the experimental group

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Figure 9: An illustrative dashboard interface of Reflective-Verbal-Sensing-Global learning style preferences in the experimental group

3.5 Phase 5: Evaluation

3.5.1 Participants

In this study, the selected participants were from Universiti Teknologi Malaysia (UTM) undergraduate students in School of Computing. From the previous studies, it was noticed that the field of Computing has the majority of gamification studies [17]. Hence, this study was conducted in Universiti Teknologi Malaysia Johor, Malaysia. Two classes have been involved with the total number of 71 undergraduate students in their 2nd year of study in School of Computing. As Table 6 showed, the first group was the experimental group with 35 participants. Participants had self-selection to specialize in major option Computer Network and Security. However, the second group was the control group and had 36 participants and specialized in Software Engineering.

Table 6: Demographic details of the participants (n =71)

Group	number	Percentage
Experimental	35	49%
Control	36	51%

In conducting the experiment, two groups of participants were chosen by the researcher. While the experimental group used the personalized mode, the control group used the non-personalized mode. Moreover, both groups undertook ILS and perceived usefulness questionnaire after and before the prototype interaction. The researcher has arranged the time and venue with the course instructor. As the time started, the researcher started with a presentation explaining the research topic, objectives, and participation roles. In addition, the procedures of the experiment and time of each procedure have been addressed. Researcher includes some illustrative examples that describe the usage of the prototype. Furthermore, details about how participants can interact with the gamified system were clarified.

The instruments of the data collection are three. First instrument is ILS questions. ILS survey was adapted in this study as one of the major sources of data. Data pertaining to students' learning styles was aimed to be captured by this questionnaire. Based on Felder and Silverman Learning Style Model, it was used by the experimental participants to indicate their learning style.

Second instrument is the prototype database. The prototype includes database that stored the data pertaining to students' learning styles and their answers. Thus, a Structure Query Language (SQL) was used to retrieve the required data associated to the research objectives

Thirdly, student's perceived usefulness about using the personalized game-based learning system is measured by this questionnaire. This questionnaire has been employed in order to explore participants' experience and feedback in term of having a helpful system or not. The questionnaire was derived from the questionnaire developed by [35]. It consists of 6 items with a five-point Likert rating scheme: (1) denotes "Strongly Disagree", (2) denotes "Disagree", (3) "Neural", (4) denotes "Agree", (5) "Strongly Agree".

After collecting the data using the prototype for both groups, data was analyzed using software analysis tool. The employed tool was SPSS version 24.0.0.0. During the analysis, a t-test has been used to compare the means to investigate the differences between the two samples: experimental and control groups. In this research, students' scores comparison between experimental and control group has been implemented to investigate whether the students' scores of experimental groups are improved or not. To reflect null hypothesis method on this study, researcher stated the null hypothesis and the tested hypothesis as follows:

H0: The mean number of the correct answers for experimental group sample is not significantly greater than the mean number of corrected answers for the control group.

H1: The mean number of the correct answers for experimental group sample is significantly greater than the mean number of corrected answers for the control group.

3.6 Phase 6: Communication

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Communication refers to the activity that researcher can convey the result of his work to the audience.

4. RESULT AND DISCUSSION

To evaluate the gamified model enriched with the features of personalization, two groups have been involved in this study with total number of 71 Individuals participants. As shown in Table 7, subsequently, groups were randomly classified into control group with 36 participants and experimental group with 35 participants. The evaluation phase has been undertaken by utilizing a prototype-based system involving 50 (MCQ) questions pertaining to DFD topic. While the experimental group has had the gamification elements were assigned to the participants based on our proposed model; refer to Figure. 3, the participants with control group has received all gamification elements. Moreover, both groups have received the same DFD questions during the experiment. We evaluated the student's scores based on their DFD questions' answers. The extracted data were analyzed by IBM SPSS Statistic Software. As shown in Table 8, table showed the results provided by SPSS comparing the means of the total students' correct answers of both groups. The mean of the experimental group was 31.8857; however, the mean of the control group was 29.7778. To compare the difference between these two means, an independent T-test was performed. The result is shown in Table 8. The P-value was calculated was 0.04. That is interpreted p-value less than or equal 0.05 indicates a strong evidence against the null hypothesis, therefore the null hypothesis is rejected. In different expression, there was statistically significant difference between the two selected samples. According to the data gathered from database, the higher average of scores was obtained by the experimental group participants. That supported the tested hypothesis. To interpret the result, experimental group students put more efforts in responding and answering the questions than control groups did. That happened because of the following reasons: Firstly, the assigned game elements provided a motivation factor for students to focus and retrieve information regarding DFD that have taken lately. Secondly, considering the learning preferences in conveying, the gamified system has engaged students in the learning process. Thirdly, the interaction with the prototype have given a precise evidence that personalized model within gamified intervention have increase their attention and involvement.

As shown in Table 9, the average ratings of the items for experimental " The DFD gamified experience is helpful to me in learning new knowledge", " I feel that I can learn better with this gamified learning approach", " Such a learning approach is more effective than other computer-assisted learning approaches I have experienced " and " The gamified learning provides the learning content in a gamefull way" are higher than control group.

Therefore, this result implies that most students in the experimental group found the personalized gamified version learning approach to be useful in improving their learning achievements.

Such finding is consistent with the analysis result of the student's scores. Based on the perceived usefulness questionnaire, it was found that most students gave positive feedback concerning both groups in the educational gamified system. The average ratings for "perceived usefulness" are 4.217 and 4.185 for the experimental group and the control group, respectively. Overall, according to the written feedback from participants, encouragement, fun, enjoyment during the learning process have been provided by the gamified learning experience.

Table 7: Descriptive Date of the students' scores variable

	Group	N	Mean	Std. Deviation	Std. Error Mean
Scores	Experimental	35	31.8857	5.69195	0.96212
	Control	36	29.7778	4.55513	0.75919

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Table 8: Independent samples test of students' scores

	t	df	P-value	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Equal variances assumed	1.725	69	.044*	2.10794	1.22174	-.329-	4.545
Equal variances not assumed	1.72	65.03	.045*	2.10794	1.22557	-.339	-4.555
*P<0.05							

Table 9: Perceived usefulness items result

NO	Questionnaire item	Group	Mean	SD
1	The DFD gamified experience is helpful to me in learning new knowledge	Experimental	4.166	0.774
		Control	4.138	0.866
2	The gamified learning approach smoothed the learning process	Experimental	4.194	0.749
		Control	4.22	0.637
*3	The gamified learning approach is helpful to me in realizing the learning content	Experimental	4.22	0.68
		Control	4.25	0.603
4	I feel that I can learn better with this gamified learning approach	Experimental	4.333	0.632
		Control	4.166	0.654
5	Such a learning approach is more effective than other e-learning approaches I have experienced	Experimental	4.166	0.696
		Control	4.138	0.723
6	The gamified learning provides the learning content in a gamefull way	Experimental	4.222	0.865
		Control	4.194	0.786
Average		Experimental	4.217	0.733
		Control	4.185	0.712

5. STRENGTHS AND LIMITATIONS

To the authors' knowledge, this is one of the fewer studies which mainly focused on distributing and evaluating the effects of certain game elements based on the learning style. For instance, study by [36], authors developed a hybrid model of gamification and eLearning in which the authors suggested the game elements for each Felder and Silverman learning style in separate table. However, the model has not been evaluated. Study by [9], authors used general learning game and only one dimension from Felder and Silverman Learning

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Style Model which is global/sequential dimension to study the effect of the game on learners. Moreover, [7] investigated the general efficiency of gamification for students based on the learning style and personality traits. Then authors advised more gamification research to be done based on the learning style and personality traits. As a result, this study has several strengths. First, this research analyzed and synthesized the impact and mechnisim of game elements on the learners as discussed in the literature (see Table 1). Second, this research utilized the most used and validated learning style model which is Felder and Silverman Learning Style Model. This model was commonly used for eLearning systems in the previous studies. Third, the grounded method used to match each learning style type with the most matching game elements to propose the personalized model. Fourth, DSRM method helped in evaluating the model. Fifth, results showed a promising evidence of considering the personalized gamified model in Learning applications such as eLearning, MOOC and mLearning. Similar to any research, this study has some limitations. As the main objective of this study is to develop the theoretical model for the game elements that are more compatible with the learning style, the researchers used a prototype web-based application for evaluation stage. Therefore, the prototype may have some shortcoming regarding its testing, features and functions. Moreover, the evaluation process was undertaken based on the experiment in class. Therefore, the period of the experiment could be short. For future work, the experiment could be executed for longer period to have more accurate result. Another limitation regarding the content of the prototype, DFD topic could be insufficient content. Hence, expanding the content by adding other learning outputs or whole course of System Analysis and Design is important to extend the evaluation of this research.

6. CONCLUSION

The aim of this research has been achieved through demonstration and evaluation phase within DSRM. A prototype has been implemented as a validation tool for the proposed model. The prototype was developed by web development application tools (PHP and MySQL Database) to produce a gamified system attached with personalization attributes. Prototype has been published online so participants had access during the experiment. Accordingly, an experiment was conducted on 71 participants chosen from UTM, Faculty of Computing. From 71 participants, 35 students were in the experimental group and 36 students were control group. The experiment lasted for almost an hour. Students interacted with DFD topic from System Analysis and Design course. The finding from the t-test of the mean of the student's score of both groups showed that the means of the student's score for control and experimental group have statistically significant difference with ($p= 0.04$). In addition, result showed the personalized gamified learning have higher perceived usefulness than non-personalized gamified learning. The contribution of this research will help researchers/ developers/ teachers in designing a gamified intervention with consideration to learning preferences. This study has some limitations. The limitations need to be further investigated in the future. Even though study has proved success in improving the learning process using the proposed personalized gamified learning, further investigations are desirable to augment the findings of this research to other learning levels and courses. Additional parameters related to personalization such as online learning behaviours, teaching styles, and prior knowledge are needed to be considered into account. Therefore, an effective learning environment for individual students will be achieved. For extended work, longer-period and larger-scale experiments are recommended within the validation process. Accordingly, empirical researches on the personalized gamified system are required involving larger participants can lead to more precise results.

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