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On The Use of Gamification in Learning Style Questionnaires: An Experiment

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ABSTRACT

Online education provides students with a flexible educational option that helps them to complete their training at their own pace. Adaptive e-learning systems are one of the most exciting areas of research in online education. To adapt a system, understanding the learner is very important, through information such as his learning style. In our system, the "learning style index" is used to identify the learning style of a user, which is a questionnaire containing 44 questions based on the Felder–Silverman learning style model (FSLSM). The aim of our research is to gamify the learning style questionnaire, to motivate users and avoid their boredom and the abandonment of the long questionnaire. An empirical study is conducted to compare the gamified and classic questionnaires. The results show that the use of our method improve user's interactions, 98% of the participants are satisfied and only 7% of them drop the questionnaire.

Keywords: ***E-learning, Education, Learning Style, Gamification, Data collection.***

I. INTRODUCTION

Over recent decades, several researchers have been drawn to the study of learning [1]. Despite its complexity, a variety of studies have discussed interesting issues, notably the concept of adaptive learning [2]. Adaptive learning can be defined as the ability of an educational system to change its behavior according to learner needs [3].

Although students get a flexible educational choice that allows them to complete their training at their own pace and on their own schedule through online education [4], the adaptation of the e-learning systems according to the needs and preferences of the students is very important [5].

One of the most interesting subject areas in E- learning is adaptive e-learning systems [6]. In the context of providing a suitable learning content, the learning styles emerge, which describe the perceptions and practices that impact a person's preferred method of learning [7]. Research indicates that each person has a distinct learning style [8]. Knowing students' preferred learning styles might help educators to detect and solve learning problems. This will motivate learners since the educator will be able to provide educational resources to meet the students' learning styles.

Researchers such as Kolb [9] and Felder & Silverman [10] have previously proposed a variety of learning style models. The Felder and Silverman learning style model (FSLSM) [10] is the most often used due to its capacity to quantify students' learning styles.

The most common way to identify learning styles according to FSLSM is through a questionnaire. Although they are reliable, these tools have some issues that can make determining learning styles challenging. These problems include Student's lack of motivation to complete a long questionnaire and their lack of awareness of the importance of knowing their learning preferences. As a result, various approaches was were presented for determining the learning style in new way [11]. We tried in our research to present the FSLSM questionnaire in a new way using the gamification. Gamification is regarded as a creative method to improve people's motivation and performance in several application domains [12]. Studies have proven that the use of gamification in specific context enhances user engagement and motivation, and that some user tasks and issues can be performed and resolved more effectively and thoughtfully [13]. The term "game elements" refers to the special and distinctive characteristics of games [14]. They serve as main ingredients of gamification, such as points, leader boards and badges. Data collection is one of the possible application for gamification [15]. Especially in the education field, data about the identification of the student's profile, such as their leaning styles, can be gathered via an

online questionnaire. Recruiting potential participants and encouraging them to complete the questionnaire form is one of the challenges of this type of data collection. The rate of early dropouts with this type of questionnaire is still another issue [16]. Reasons for that could be the participant's lack of motivation, the length of the questionnaire or its unattractive design. Many times, people find questionnaires boring, but they do not immediately interrupt them. The concern is that the questions are read less intently, resulting to replies that are more likely to be incorrect.

In this paper, we proposed the gamification of FSLSM questionnaire, which aims to solve these problems, and encourage learners to start the questionnaire and motivate them to end it. The main goal of the proposed model is to transform the classic FSLSM questionnaire for learning style identification to a gamified questionnaire to determine learner preferences and identify learner styles in order to provide suitable learning resources to the user needs. The rest of the paper is organized as follows: Section 2 explains the concept of learning style questionnaire; Section 3 presents our research design; Section 4 shows the evaluation of our proposal; Section 5 includes the discussion of the results; and Section 6 are our conclusions.

II. RELATED WORK

Recent studies on the learning process have shown that when educators' teaching methods correspond with their learners' preferred learning style, the efficiency of the learners' education has increased [17]. It is necessary to identify each learner's learning style in order to adapt the courses to fit their needs and to close the gap between educators and students.

The most popular method to obtain the learning style is using the FSLSM questionnaire [18]. Although this method can accurately determine a student's learning style, learners may not have the time or interest to complete long questionnaires [Mwamikazi 2014]. Several research have tried to address these restrictions by providing this questionnaire in a different manner. Mwamikazi [19] have proposed a flexible computerized questionnaire that dynamically chooses new questions based on previous answers, thus reducing the total number of questions.

Following the appearance of LMSs (Learning Management Systems) in education, using an automatic detection method to determine the learning style in a dynamic and indirect way became more appropriate. Various research have proposed new methods to detect learning styles automatically based on the FSLSM.

Ikawati [20] suggests the use of the decision tree algorithm and the ensemble gradient boosted tree method to automatically predict learning styles based on FSLSM. Another study was conducted by Ahmadaliev [21], who presented a web-based interactive tool to initiate students' learning styles. The method uses learner's interaction with learning resource as hint to predict the student's learning style.

The main limitation of the mentioned studies is that their approach determines students' preferences during class based on the learner's interaction with the learning system. The automatic system can only predict the learning style after detecting certain reaction of the user and the analysis reveals results gradually, perhaps during the middle or end of the course. Furthermore, most systems follow significant trends [22]. Additionally, the automated system can make a decision based on actions or choices that the user had made carelessly just to experiment or consult, which results in an inaccurate detection of the learning style. Besides several researchers have already employed the Learning Style Index (ILS), which is based on the FSLSM, successfully, and it has a high level of validity and reliability [23]. To the best of our knowledge, determining the student's learning preferences at the beginning of LMS sessions is still lacking. In our LMS, we propose the gamification of FSLSM questionnaire using game elements to motivate learners to fill the questionnaire, which will allow us to determine the learner learning style in the beginning.

III. LEARNING STYLE QUESTIONNAIRE

In this paper, we consider Felder–Silverman learning style model (FSLSM), because it is the most frequently used learning style model. In this vein, Shockley and Russell [24] found that the FSLSM model is the most prevalent (50%), significantly outpacing Kolb's model (8.6%), according to an analysis of learning style models' utilization in adaptive learning systems over the previous ten years. Furthermore, FSLSM offers reliable statistics and more extensive descriptions than other learning style models. The questionnaire method has been successfully demonstrated as a behavioral model in the engineering education system, and FSLSM learning styles are the most appropriate for engineering learners [25].

The FSLSM defines four dimensions: Preprocessing, Perception, Input and Understanding. There are two different learning styles used to determine each dimensions, which can be viewed as learning preferences opposites of each other. The user's learning preferences are determined by combining their particular learning styles from each component. A description of each dimension's two learning preferences is provided in Table I.

To identify the styles of learning Richard M. Felder and Barbara A. Solomon created a Learning Style Index (ILS) in 1991 based on the FSLSM [10] to determine the degree of preference as well as the preference itself, and in 1996 it was added to the World Wide Web. ILS is a 44 item questionnaire with 11 questions on each of the four dimensions [26]. The ILS scales are bipolar, with either (a) or (b) as the only valid responses to each item. Given that each scale has an odd number of items, the total score on a scale from -11 to +11 reveals an increasing preference for the given modality if items are rated as +1 and -1, respectively [27].

TABLE I. THE LEARNING STYLES DIMENSIONS

Learning types		Dimension's learning types	
Processing:	This section describes how information is interpreted and converted into knowledge.	Active:	Active learners are not very effective when forced to be passive. They work well in groups and are open to trying new things.
		Reflective:	Reflective learners do not learn much when there is limited opportunity to consider the information being presented. They prefer to work alone or with just one other person.
Perception:	This dimension is focused on the informational preferences of the learner.	Sensitive:	Experimentation, data, and facts are a few examples of sensitive sensors. They dislike "surprises" and prefer to use tried-and-true methods to handle problems. When it comes to small matters, they are patient, but they hate challenges. Although they can be slow, sensors are good at remembering information and exercising caution.
		Intuitive:	Intuitive learners prefer theory and principles. They love fresh ideas and hate the same old thing. They enjoy issues because they find detail boring. Although intuitive people pick up new ideas quickly and well, they might make mistakes.
Input	This factor assesses how students prefer to obtain knowledge from outside sources.	Visual:	Visual learners remember images, diagrams, flow charts, timelines, videos, and demonstrations the best
		Verbal:	Images, diagrams, flow charts, timelines, movies, and demonstrations are retained more clearly by visual learners. The top Verbal learners retain a lot of the information they hear, and they retain even more of the information they hear and then express.
Understanding	This part outlines the method by which students acquire understanding.	Sequential:	Sequential learners can deal with knowledge that they only have a basic understanding of and solve problems utilizing linear thinking methods.
		Global:	Global learners may not be able to explain how they arrived at solutions because they make intuitive jumps. Additionally, they could struggle to understand only some of the information.

A score on the scale of 1 to 3 indicates a balanced preference on the two dimensions of a scale. If a student receives a score of 5-7 on a scale, it can be assumed that they have a moderate preference for one of the scale's dimensions and will learn more readily in a classroom environment that supports that dimension. If a person has a scale score of 9 to 11, they likely have a strong preference for one of the scale's dimensions and may find it difficult to learn in an environment that does not support his preference. As an example, we consider the active-reflective dimension, 0 or 1 of 'a' response would indicate a strong preference for reflective learning, a response of two or three would suggest a moderate preference for reflective learning, four or five would suggest a noticeable preference, six or seven would suggest a mild preference for active learning, eight or nine would suggest a moderate preference for active learning, and ten or eleven would suggest a strong preference for active learning.

IV. USING RESEARCH DESIGN AND PROPOSAL

Leaning management systems (LMSs) such as Sakai (https://www.sakailms.org) are frequently and successfully used in E-learning because their main aim and purpose is to help teachers and learning providers in making and delivering online courses. The search for new approaches having the capacity to maximize the subjective satisfaction of the learner by taking into account the learning situations has become essential. Learners' learning styles can be used in a variety of ways to better understand learners and improve learning and teaching.

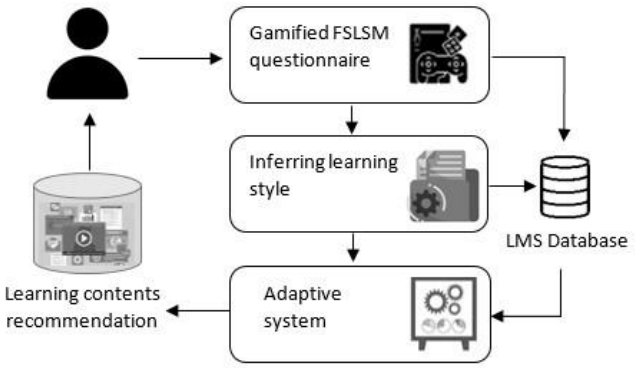

Figure 1: Our research design main blocks.

The goal of our research is to improve our platform based on Sakai LMS. We propose an adaptation system that allows us to recommend learning content suitable to the needs of learners. To that end, we need to know the learning style of each user (see Figure 1).

In our paper, we aim to use the gamification in learning style questionnaire created by Richard M. Felder, and Barbara A. Soloman [26] in order to avoid the abandonment of the questionnaire, since a significant part of the users could get bored of filling out a long survey. Gamification is mainly used to improve user motivation and engagement [28]. For this reason, we have adopted the game elements to motivate the user to answer questions to determine their learning style and allow them to be aware of what they are doing and why to do it. On the other hand, the results can be used in the adaptation

of the content to provide the learner with content that matches these needs and preferences.

With the purpose of validating the gamified questionnaire, an empirical study was carried out. Two-questionnaire versions were used (see Figure 2): a classic and a gamified questionnaire were proposed to allow us to compare the results of user responses. The classic questionnaire (Figure 3), which is based on FSLSM questionnaire, was employed to create a gamified questionnaire (Figure 4), which was expanded with game components. To generate the online questionnaire, open-source programs and libraries were used. The classic questionnaire was implemented as a web application, using HTML and CSS based on Bootstrap on the front end. For backend development, PHP was chosen. The gamified questionnaire was developed on C# using Unity 2020 and Visual Studio.

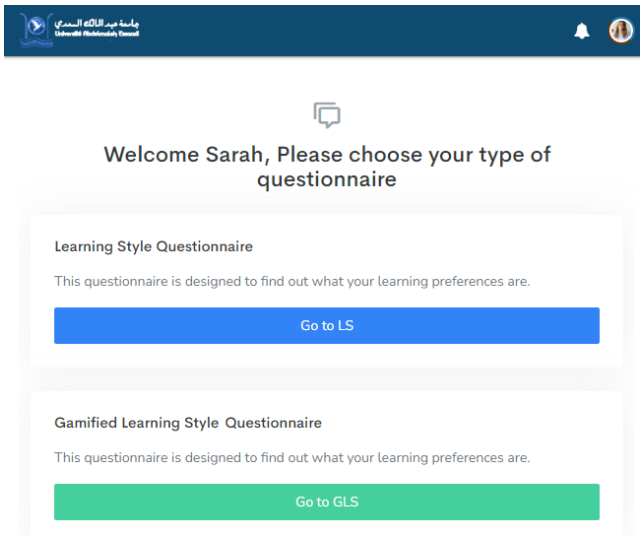

Figure 2 : Learning Style Questionnaire type choice.

The classic questionnaire consists of questions in the form of a multiple-choice questionnaire (MCQ) and includes a simple design. Furthermore, for the creation of the gamified questionnaire, the existing procedure of the questionnaire was slightly modified and enriched with additional animations. In order to get the full attention and concentration of users, a design with several illustrations and rounded edges was used. The gamified questionnaire used a conversation between avatars, a highlighted selection indicator, progress bar, and multiple badges as game design elements. The dialog and associated avatars were chosen to explain why learning style is important to learn. It gives additional meaning to the activity to be performed and it has been scientifically proven that the human brain processes information much more easily, when it is embedded in a context [29]. Users strongly prefer applications with progress indicators, as they can estimate how long, for example, the computation time or load process of an application will take [30]. Badges have also motivational factors. For example, they define goals that users can use to align themselves with, they indicate how the system is structured and show what opportunities users have in the system [31].

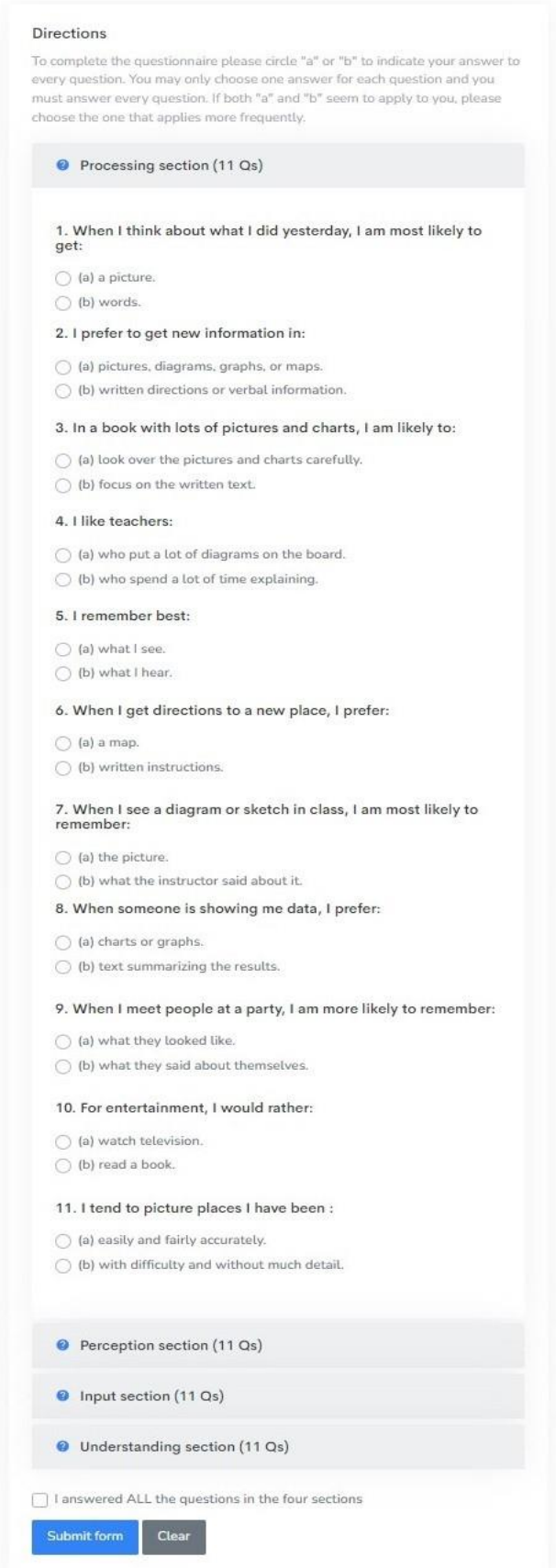

Figure 3: The classic Learning Style Questionnaire.

Figure 4: The gamified Learning Style Questionnaire.

V. RESULTS AND DISCUSSION

The current study was carried out at Abdelmalek Esaadi University. Sixty students participated in our experiment. Participants range in age from 20 to 30 years old, with 55% of bachelor's, 25% master's, and 20% of PhD students. The participants are studying in diverse disciplines, including computer mathematics, biological sciences, physics, and chemistry. In terms of the participants' gender, 60% are female and 40% are male. As mentioned in Section IV, there are two questionnaires, the classic and the gamified version, which are both based on FSLSM questionnaire. The participants were randomly divided into two groups. The first group of thirty participants took the gamified questionnaire and the other thirty took the non-gamified or classic questionnaire. The control group was the one that took the classic questionnaire, and the treatment group was the other. We have two types of dependent variables: (i) “objective” variables: completion time, response rate and dropout rate; and (ii) “subjective” variable: perceived satisfaction.

A. Processing time during the completion process of the questionnaire

Table II shows the average of the processing time for the different questionnaire types. The average of processing time can be calculated by dividing the processing time sum of the questionnaire by the total number of participants who take the questionnaire. The processing time to complete the gamified questionnaire tends to be longer than the classic questionnaire. In addition, the median of the Processing time, the Maximum completion time and Minimum completion time were longer in the gamified questionnaire. One reason for this might be that users have spent more time answering the particular questions, which gave them the opportunity to analyze each question carefully, while in the non-gamified version of the questionnaire the participants may not devote enough time to read each question. The very design of the gamified questionnaire favors focusing attention on one question at a time, whereas in the classic questionnaire it is easy to quickly read the questions and answers. According to the analysis of the results obtained, it can be said that the gamified questionnaire tends to improves the concentration on the analysis of the questions proposed, which helps the learner to understand and answer the questionnaire well. The results of the questionnaire, therefore, will be more realistic and correct and the learning style will be determined more accurately.

TABLE II. PROCESSING TIME DURING THE COMPLETION PROCESS OF THE QUESTIONNAIRE.

	Processing time average	**Processing time median**	**Maximum completion time**	**Minimum completion time**
Classic questionnaire	00:01:09	00:00:55	00:06:25	00:00:40
Gamified questionnaire	00:04:35	00:02:45	00:10:25	00:01:25

B. Response rate

The response rates for the conventional and gamified questionnaires are shown in Table III. The response rate is calculated by dividing the number of started questionnaire instances by the total number of students. In this regard, the two types of questionnaires tend to have very close results. The assumption here is that most of the participants intended to discover their learning style with either a classic or a gamified questionnaire.

TABLE III. *RESPONSE RATE*

	Classic questionnaire	Gamified questionnaire
Response number	28	29
Response rate %	93%	94%

C. Dropout rate

Table IV shows the dropout rates for the classic and the gamified questionnaire. Dropout rate is a percentage of respondents who did not complete the questionnaire. Dropout rates for the traditional and gamified questionnaires were 26% and 7%, respectively. The dropout rate of the gamified questionnaire is less than that of the classic questionnaire, so these findings confirm the hypothesis of our research, since the gamified questionnaire was proposed to motivate participants to complete the questionnaire even if learners may lack motivation and time to fill in long questionnaires. The possible reason for this low dropout rate is probably that the participants had enjoyed filling out the gamified questionnaire thanks to the use of game design elements.

In general, we can deduct from this result that the gamified questionnaire attracted and motivated users to continue answering the questionnaire, especially that the user receives results of his learning style at the end of each dimension's stage before moving on to the following step. The user felt like he was doing 4 questionnaires of 11 questions which did not seem boring to him.

TABLE IV. *DROPOUT RATE.*

	Classic questionnaire	Gamified questionnaire
Dropout number	6	2
Dropout rate %	26%	7%

D. Perceived Satisfaction

To obtain the measure of perceived satisfaction we divided the total number of respondents who are “very satisfied” or “satisfied” by the total number of responses. Regarding the participant satisfaction mentioned on Table V, the use of game elements might have an impact on learner’s satisfaction, given that 98% and 74% of the participants of the gamified and classic questionnaire, respectively, were satisfied. This is also a positive outcome of the proposal presented in this work, given that the level of satisfaction among participants could be an indication that they feel the task they have undertaken is useful and beneficial.

Moreover, user satisfaction is related in the first place to the confirmation of expectation. In both models the users find what they were looking for, since they discovered their learning style. In addition, in the gamified questionnaire we have given more importance to information of learning style through a dialogue that allows them to understand what their learning style is, its use and importance and how to discover it. According to the information integration theory, the importance given reflects the interest devoted to this situation [33]. The users gave more interest to the gamified questionnaire because they understood its importance, and this is undoubtedly reflected in their satisfaction.

TABLE V. *PERCEIVED SATISFACTION.*

	Classic questionnaire	Gamified questionnaire
Perceived satisfaction %	74%	98%

VI. CONCLUSION

Our research aims to gamify the FSLSM questionnaire, to encourage and motivate users to complete the questionnaire while answering a 44-question quiz. The proposed method's main objective is to convert the classic FSLSM questionnaire for learning style identification into a gamified questionnaire to identify learner styles of the user. Eventually, this strategy can be used to provide adequate learning resources to learners in the context of an LMS. To validate our proposal, the results when using the gamified and the classic questionnaire were compared. The analyses of the results reveals that the use of the gamified questionnaire to identify participants' learning styles resulted improvements in user interaction but the number of participants is still not enough to provide confirmed conclusion. The number of participants must be increased to obtain more precise results concerning the two versions of the questionnaire. According to the results obtained, the design of the gamified questionnaire can be applied rather than the classic questionnaire. Therefore, we have adopted the gamified questionnaire in our Sakai platform. The use of gamification on education is considered an innovative approach to motivate learners [34]. The future research can be done on the use of gamification on data collection to measure other learners’ characteristics such us knowledge background and others to improve the adaptation of resources and improve educational process on our Sakai platform.

REFERENCES

[1] Y. Bai, H. Li, and Y. Liu, “Visualizing research trends and research theme evolution in E-learning field: 1999–2018,” Scientometrics, vol. 126, no. 2, pp. 1389–1414, 2021, doi: 10.1007/s11192-020-03760-7.

[2] S. Ennouamani and Z. Mahani, “An overview of adaptive e-learning systems,” 2017 IEEE 8th Int. Conf. Intell. Comput. Inf. Syst. ICICIS 2017, vol. 2018-Janua, no. December, pp. 342–347, 2018, doi: 10.1109/INTELCIS.2017.8260060.

[3] M. Vandewaetere, P. Desmet, and G. Clarebout, "The contribution of learner characteristics in the development of computer-based adaptive learning environments," Comput. Human Behav., vol. 27, no. 1, pp. 118–130, 2011, doi: 10.1016/j.chb.2010.07.038.
[4] W. Ali, "Online and Remote Learning in Higher Education Institutes: A Necessity in light of COVID-19 Pandemic," High. Educ. Stud., vol. 10, no. 3, p. 16, 2020, doi: 10.5539/hes.v10n3p16.
[5] M. del P. P. Ruiz, M. J. F. Díaz, F. O. Soler, and J. R. P. Pérez, "Adaptation in current e-learning systems," Comput. Stand. Interfaces, vol. 30, no. 1–2, pp. 62–70, 2008, doi: 10.1016/j.csi.2007.07.006.
[6] C. N. Pfeiffer and A. Jabbar, "Adaptive e-Learning: Emerging Digital Tools for Teaching Parasitology," Trends Parasitol., vol. 35, no. 4, pp. 270–274, 2019, doi: 10.1016/j.pt.2019.01.008.
[7] M. A. Hassan, U. Habiba, F. Majeed, and M. Shoaib, "Adaptive gamification in e-learning based on students' learning styles," Interact. Learn. Environ., vol. 29, no. 4, pp. 545–565, 2021, doi: 10.1080/10494820.2019.1588745.
[8] S. McLeod, "Kolb ' s learning styles and sxperiential learning cycle," SimplyPsychology, pp. 1–8, 2017, [Online]. Available: https://www.simplypsychology.org/learning-kolb.html
[9] D. A. Kolb, "Experiential Learning: Experience as The Source of Learning and Development," Prentice Hall, Inc., no. 1984, pp. 20–38, 1984, doi: 10.1016/B978-0-7506-7223-8.50017-4.
[10] N. C. S. U. Felder Richard M. and I. for the S. of A. D. Silverman Linda K., "Learning and Teaching Styles in Engineering Education," Engr. Educ., vol. 78(7), pp. 674–681, 1988.
[11] F. Rasheed and A. Wahid, "Learning style detection in E-learning systems using machine learning techniques," Expert Syst. Appl., vol. 174, no. February, 2021, doi: 10.1016/j.eswa.2021.114774.
[12] Z. Zainuddin, S. K. W. Chu, M. Shujahat, and C. J. Perera, "The impact of gamification on learning and instruction: A systematic review of empirical evidence," Educ. Res. Rev., vol. 30, no. March 2019, 2020, doi: 10.1016/j.edurev.2020.100326.
[13] C. Borrego, C. Fernández, I. Blanes, and S. Robles, "Room escape at class: Escape games activities to facilitate the motivation and learning in computer science," J. Technol. Sci. Educ., vol. 7, no. 2, pp. 162–171, 2017, doi: 10.3926/jotse.247.
[14] J. R. Chapman and P. J. Rich, "Does educational gamification improve students' motivation? If so, which game elements work best?," J. Educ. Bus., vol. 93, no. 7, pp. 314–321, 2018, doi: 10.1080/08832323.2018.1490687.
[15] Supriyanto, J. Fahana, and S. Handoko, "Gamification to Improve Digital Data Collection in Ecotourism Management," Proc. - 2nd East Indones. Conf. Comput. Inf. Technol. Internet Things Ind. EIConCIT 2018, pp. 139–142, 2018, doi: 10.1109/EIConCIT.2018.8878581.
[16] M. Hoerger, "in Internet-Mediated University Studies : Implications in Psychological Research," Cyberpsychology, Behav. Soc. Netw., vol. 13, no. 6, pp. 697–701, 2010.
[17] A. P. Gilakjani, "A Match or Mismatch Between Learning Styles of the Learners and Teaching Styles of the Teachers," Int. J. Mod. Educ. Comput. Sci., vol. 4, no. 11, pp. 51–60, 2012, doi: 10.5815/ijmecs.2012.11.05.
[18] J. Feldman, A. Monteserin, and A. Amandi, "Automatic detection of learning styles: state of the art," Artif. Intell. Rev., vol. 44, no. 2, pp. 157–186, 2015, doi: 10.1007/s10462-014-9422-6.
[19] E. Mwamikazi, P. Fournier-Viger, C. Moghrabi, A. Barhoumi, and R. Baudouin, "An adaptive questionnaire for automatic identification of learning styles," Lect. Notes Artif. Intell. (Subseries Lect. Notes Comput. Sci., vol. 8481, no. 2014, pp. 399–409, 2014, doi: 10.1007/978-3-319-07455-9_42.
[20] Y. Ikawati, M. U. H. Al Rasyid, and I. Winarno, "Student Behavior Analysis to Detect Learning Styles in Moodle Learning Management System," IES 2020 - Int. Electron. Symp. Role Auton. Intell. Syst. Hum. Life Comf., pp. 501–506, 2020, doi: 10.1109/IES50839.2020.9231567.
[21] D. Q. Ahmadaliev, C. Xiaohui, and M. Abduvohidov, "A Web-based instrument to initialize learning style: An interactive questionnaire instrument," Int. J. Emerg. Technol. Learn., vol. 13, no. 12, pp. 238–246, 2018, doi: 10.3991/ijet.v13i12.8725.
[22] X. Tsortanidou, C. Karagiannidis, and A. Koumpis, "Adaptive educational hypermedia systems based on learning styles: The case of adaptation rules," Int. J. Emerg. Technol. Learn., vol. 12, no. 5, pp. 150–168, 2017, doi: 10.3991/ijet.v12i05.6967.
[23] R. M. Felder and J. Spurlin, "Applications, reliability and validity of the index of learning styles," Int. J. Eng. Educ., vol. 21, no. 1 PART 1, pp. 103–112, 2005.
[24] D. R. SHOCKLEY, "Learning Styles and Students' Perceptions of Satisfaction in Community College Web-based Learning Environments," 2005.
[25] S. V. Kolekar, R. M. Pai, and M. M. Manohara Pai, "Adaptive User Interface for Moodle based E-learning System using Learning Styles," Procedia Comput. Sci., vol. 135, pp. 606–615, 2018, doi: 10.1016/j.procs.2018.08.226.
[26] B. a Soloman, N. Carolina, and R. M. Felder, "Index of Learning Styles Questionnaire," Learning, no. January 1999, pp. 1–5, 2012, [Online]. Available: http://www.engr.ncsu.edu/learningstyles/ilsweb.html
[27] M. S. Zywno, "A contribution to validation of score meaning for Felder-Soloman's Index of Learning Styles," ASEE Annu. Conf. Proc., pp. 2855–2870, 2003, doi: 10.18260/1-2--12424.
[28] Sekaran et al., "THE EFFECT OF GAMIFICATION ON STUDENTS' ENGAGEMENT AND MOTIVATION IN THREE WSU COURSES," Pakistan Res. J. Manag. Sci., vol. 7, no. 5, pp. 1–2, 2018, [Online]. Available: http://content.ebscohost.com/ContentServer.asp?EbscoContent=dGJyMNLe80Sep7Q4y9f3OLCmr1Gep7JSsKy4Sa6WxWXS&ContentCustomer=dGJyMPGptk%2B3rLJNuePfgeyx43zx1%2B6B&T=P&P=AN&S=R&D=buh&K=134748798%0Ahttp://amg.um.dk/~/media/amg/Documents/Policies and Strategies/S
[29] F. Teixes, "Actionable gamification: Beyond points, badges, and leaderboards," Octalysis Media, pp. 1–151, 2017, [Online]. Available: https://leanpub.com/actionable-gamification-beyond-points-badges-leaderboards/read
[30] B. A. Myers, "Importance of Percent-Done Progress Indicators for Computer-Human Interfaces.," no. April, pp. 11–17, 1985, doi: 10.1145/1165385.317459.
[31] Z. Li, K. W. Huang, and H. Cavusoglu, "Quantifying the impact of badges on user engagement in online Q&A communities," Int. Conf. Inf. Syst. ICIS 2012, vol. 5, pp. 3798–3807, 2012.
[32] A. Bhattacherjee, "Understandinignformatiosnystems Continuancea: An Expectation-Confirmatiom Model," MIS Quarterly, vol. 25, no. 3, pp. 351–370, 2001.
[33] N. H. Anderson, "Integration theory and attitude change," Psychol. Rev., vol. 78, no. 3, pp. 171–206, 1971, doi: 10.1037/h0030834.
[34] J. Majuri, J. Koivisto, and J. Hamari, "Gamification of education and learning: A review of empirical literature," CEUR Workshop Proc., vol. 2186, no. GamiFIN, pp. 11–19, 2018.