Investigating Student's Cognitive Engagement, Motivation and Cognitive Retention in Learning Management System

https://doi.org/10.3991/ijet.v17i09.29727

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Abstract—Online learning has grown significantly in recent years, due to the proliferation of online courses offered by universities. As a result, pedagogical guidance is critical for improving teaching quality in an online learning environment. In this study, Inquiry-Based Learning (IBL) activities were developed with the aim of increasing students' cognitive engagement, cognitive retention, and motivation to learn. This study also investigated the effects of the IBL pedagogical method on student performance. A pre-experimental study was conducted with 16 undergraduate students enrolled on a Multimedia Design and Human Computer Interaction course. Learning Analytics (LA) was used to retrieve research data from a Learning Management System (LMS) online discussion forum, and the data was then analyzed using content analysis and data mining analysis. According to the findings, students perceived a higher rate of low-level cognitive engagement but, interestingly, a high level of cognitive retention and motivation. Meanwhile, a significant relationship was observed between students' cognitive engagement, motivation and cognitive retention.

Keywords—learning analytics, online learning, inquiry-based learning, learning management system

1 Introduction

One of the major challenges while learning online is the issue of learners dropping out of the course. A sense of isolation, the autonomy required and the need to take responsibility for their own learning often remain on students' minds, causing them to feel burdened and unaided [1]. As online learning can be undertaken at any time, many students make the decision to withdraw from their online classes at many levels of learning [2]. As a result, the attrition rates of online classes are significantly higher than those of traditional classes, particularly when large-scale online learning environments are involved [3]-[4].

This situation has been demonstrated through the retention rate of online courses, which has been recognized as being higher than the equivalent rate for traditional classrooms, with percentages of 10% and 20%, respectively [5]-[6]. Instances of students dropping out while learning online have also attracted researchers to examine student

engagement, particularly cognitive engagement, as this is highly related to learning [7]. [8], in his social learning theory, claimed that learners tend to achieve a higher state of engagement in tasks or activities when they feel competent and confident while learning. This also applies to the aspect of motivation, which has been noted as a cause of online attrition [9]-[10], [5], [11]-[12]. This occurs when there is a lack of the key dimensions that create motivation among students in online learning environments.

Hence, the reasons why students leave their classes while learning online and the potential solutions to this problem are among the themes that need further research [2]. As previous research on learning analytics (LA) shows, motivation, cognitive engagement and cognitive retention have been highlighted as being separate fields. Another study aimed to apply learning analytics to observe learners' online learning behavioral patterns through different levels of online learner motivation [13]. Meanwhile, research has used students' data to improve course retention rates by promoting students' motivation and monitoring individual students' online activities or engagement, as in [14].

As learners need to interact with teachers, peers and educational resources during the learning process, a specific method of learning must be designed so that they can maximize the value of these interactions [15]. Hence, in this study, a model of inquiry-based learning (IBL) was applied to suit and cater to these learning needs. IBL was chosen due to its questioning process, which contributes to students' reflection, discourse, analysis and knowledge construction [16].

Therefore, this paper examines how IBL functions by enhancing students' cognitive engagement, cognitive retention and motivation via a Learning Management System (LMS). The objectives of this study are as follows:

1. To design an online inquiry-based learning environment for a Learning Management System (LMS)
2. To identify students' cognitive engagement, cognitive retention, and motivation through a Learning Management System (LMS)
3. To identify the relationships between students' cognitive engagement and motivation on one hand, and students' cognitive retention on the other, through a Learning Management System (LMS)

2 Literature review

2.1 Inquiry-based learning

According to [17], IBL is defined as "an instructional process in which students are encouraged to develop discipline knowledge and skills by engaging in a self-initiated problem-solving cycle". Put more simply, IBL is regarded as a process involving learners' personal discoveries [18]. IBL is one of the most influential pedagogies as it can provide better alternatives for optimizing online learning quality, while it can also improve learners' satisfaction. Several researchers have suggested that the implementation of one-to-one technology initiatives benefits students, teachers and districts by increasing inquiry-based teaching methods [19]-[21]. Another study by [22] proposed

combining technology-enhanced settings with an inquiry-based learning (IBL) approach to optimize the design and development of virtual online learning activities. According to the researchers, the use of IBL models in technology may encourage learners to become motivated to generate their own problem-solving techniques, thus enabling more meaningful and self-regulated learning.

In addition, IBL aims to function as an exemplary model with which teachers can enhance their students' cognitive presence in online settings. Mason [16], in his research entitled "Cognitive Engagement and Questioning Online", discussed a range of issues associated with support for inquiry-based learning and deep reasoning while utilizing information and communication technology (ICT). IBL resembles a question-driven approach to learning [23] that enables students to learn by asking questions and finding answers related to a lesson. Asking questions is an important foundation of learning, a view supported by [24]. Another issue related to IBL can be found in a study by [25], which focused on pre-services teachers' experiences of learning to design a form of technology that supported an IBL environment using WebQuest, the inquiry-oriented lesson format.

Although IBL is widely used in many fields of study, in no case can its validity and effectiveness be proven. This is particularly true for the area that focuses on students' learning needs, which comprises all of the students' motivation and cognitive engagement in relation to the students' cognitive retention in an online learning environment. Hence, in this study, the IBL model presented by [26] was chosen as a framework with which to investigate these learning needs through a Learning Management System.

2.2 Learning Management Systems (LMS)

An LMS is generally considered a basic tool that is made available for teachers and students to support their academic processes and activities [27]. This tool includes content sharing, communication, a calendar, admissions, collaboration and assessment capabilities [28]. Furthermore, LMS platforms are often used widely in the context of Higher Education Institutions [29] and across many universities to upgrade the quality of education and academic performances [30], [31]. A total of 99% of colleges and universities are currently reported to have an LMS application on site [32]. Due to the competitive nature of the higher education market, an LMS that is highly adaptable and sufficiently flexible to integrate future technologies is said to be a wise investment for any university [33].

These systems are regarded as far from satisfactory [34] and do not provide ample learning activity reports with which instructors can effectively devise learning plans that meet their students' needs [35]. For that reason, new expanded features of LMS systems have been introduced, one of which is the analytics tool. Using this system, teachers can access and acknowledge the majority and outstanding performances of their classes [36]. The data results obtained via this type of platform can be viewed on visual dashboards by teachers, while results can also be reviewed by students [37]. Moreover, these analytics systems are also being merged at the departmental or institutional level, allowing student tracking, student management and curriculum mapping, features that improve the inclusive coherence of a course [28].

2.3 Cognitive engagement, cognitive retention and motivation in online learning

According to [38], student engagement refers to the quality of students' own efforts to participate in educationally purposeful activities that contribute directly to the course results. The term can also be defined as "students' time-on-task and willingness to participate in activities, interest, effort and motivation" [39]. Previous research has proven that students who are actively engaged in class tend to have higher chances of completing a course, a lower tendency to drop out of school [40] and a greater likelihood of achieving academically [41]-[42].

Despite the suggested ways to engage online students, which can be classified into three dimensions - behavioral, emotional and cognitive [40], [43] - [45] concerns are still being raised as to the certainty with which cognitive engagement occurs in online classes. This is because cognitive engagement is believed to have a strong and close connection to learning as it involves learners' reflection [45] and mental efforts as part of classwork [45]. Cognitive engagement can be defined as students' willingness and ability to handle the learning tasks and activities close at hand [46]. This dimension includes self-regulation, the commitment to master learning and the use of studying strategies [47]. This type of engagement remains significant in online learning environments as it promotes students' autonomy and the need for them to take responsibility for their own learning [45].

On the other hand, cognitive retention in education is neither a new concept nor a new area of study. However, few studies have been conducted on cognitive retention in online learning environments. Online learning follows a constructivist model, whereby teachers are only responsible for providing props to their students and assisting them whenever necessary [2]. This can be quite frustrating for students who are not comfortable with self-learning and constructing knowledge of their own. If cognitive retention in a traditional classroom is important in determining students' academic performances, the concept of cognitive retention in online based is equally so. Nevertheless, measuring the cognitive retention process among students in online classes cannot be generalized as it can with face-to-face courses; otherwise, this may contribute to the increasing attrition rates.

Additionally, research evidence motivation as a key determinant of learners' success or failure in learning environments [48]. Therefore, it resembles the other types of learning; fostering adequate motivation is also a crucial element that must be included when determining the success of online learning [49], as well as improving students' academic performance [50]. Professionals who work particularly in the area of education and psychology have expressed concern about several aspects of motivation, including attention, interest, effort, commitment and satisfaction [51-52], which led this study to identify students' motivation while learning online. Nevertheless, studies that explore motivation within online settings are very limited in either number or scope, as researchers have noted [53]. Hence, a growing body of literature highlights motivation in online contexts as a topic that demands further investigation [54].

In this study, students' motivation in online learning was measured through content analysis of the LMS discussion forum. For content analysis, motivation levels were

identified based on Keller's ARCS Model of Motivational Design Theories [48], which examines: (1) attention, (2) relevance, (3) confidence and (4) satisfaction.

3 Methodology

3.1 Research design

A one-group posttest pre-experimental research design was used in this research. Changes in the outcome of interest were presumed to be the result of the intervention or treatment. That is, no control or comparison group was employed.

3.2 Population and sample

The target population for this study was undergraduate students who were actively using an LMS as their learning platform. A sample from the population was selected based on purposive sampling. A total of 16 students from an Educational Technology course were taken as a sample for this study.

3.3 Research instrument

In this research, a forum discussion was established on the Learning Management System (LMS) to observe students' cognitive engagement, cognitive retention, and motivation. Meanwhile, learning activities were provided by the instructor, following the IBL pedagogical method developed by [26]. Four instruments were used in this study: (i) The Cognitive Engagement Coding Scheme by [55], (ii) The Cognitive Retention Coding scheme by [56], (iii) a motivation coding scheme and (iv) pre- and post-tests. For this study, the four principles of the IBL pedagogical method developed by [26] were used to construct the learning activities that students undertook via the LMS. The principles are mentioned below:

a) Principle 1: Learners are at the center of the entire process, while the instructors, resources and technology must be adequately organized to support them.
b) Principle 2: All learning activities revolve around information-processing skills.
c) Principle 3: Instructors facilitate the learning process but also seek to learn more about their students and the process of inquiry-based learning.
d) Principle 4: Emphasis should be placed on evaluating the development of information-processing skills and conceptual understanding, not on the actual content of the field.

By implementing the IBL pedagogical method in the creation of learning activities on the LMS platform, the instructor were seen to play a major role in ensuring students' participation. The instructors need to facilitate the student experience with continuous inquiries throughout the learning process.

4 Results

4.1 Investigating students' cognitive engagement, cognitive retention and motivation via a Learning Management System (LMS)

Out of 18 components of the cognitive engagement coding scheme created by [55], only 14 components of the cognitive engagement coding scheme could be found in the students' responses. The components were labeled CHV1, which was coded five times, *CHV2 (two times), CHVER (one time), *CHG2 (108 times), CI 1 (29 times), *CI 2 (24 times), CIT (62 times), CIE (35 times), ACCEPT- (four times), *ACCEPT+ (11 times), A (34 times), AND (seven times), RINS (one time) and GREE (nine times). The other four components of cognitive engagement - labeled CHG, NACCEPT-, *+NACCEPT and RV - were not identified at all in the students' responses on the LMS.

The cognitive engagement coding used with the highest frequency by students during the LMS discussion was *CHG2, which occurred about 108 posting times, followed by CIT (62 times), CIE (35 times) and A, which occurred about 34 times in four weeks. This finding indicates that the students were more inclined to answer the questions given by the instructors with further elaboration; provide answers that referred to earlier information or remarks; conclude or summarize a statement; and express their emotions and feelings regarding the other participants or the task given. The cognitive engagement codings used with the lowest frequency by students were CHVER and RINS, which were each posted one time only. These two components indicate that students were least interested in asking questions while discussing topics on the LMS platform. The reported results of the frequency of students' posts according to the level of cognitive engagement are displayed in Table 1.

Table 1. Frequency of cognitive engagement on the LMS

Components		Total
Cognitive: Asking Questions	CHV 1	5
	*CHV2	2
	CHVER	1
Cognitive: Giving Answers	CHG1	0
	*CHG2	108
Cognitive: Giving Information	CI 1	29
	*CI 2	24
	CIT	62
	CIE	35
	ACCEPT-	4
	*ACCEPT+	11
	NACCEPT-	0
	*NACCEPT+	0
Affective	A	34
Regulative	RV	0
	RINS	1
Rest	AND	7
	GREE	9

To identify the students' cognitive retention, the coding scheme proposed by [56] was used in this study. Students' cognitive retention was measured through their discussions on the LMS. Generally, students' cognitive retention levels were found to be considerably high, as described in Table 2.

Table 2. Frequency of cognitive retention in the LMS

Student ID	High Cognitive Retention	Low/Medium Cognitive Retention	Irrelevant	Total
S1	15	0	0	15
S2	15	1	1	17
S3	10	2	0	12
S4	12	5	1	18
S5	8	4	4	16
S6	7	1	0	8
S7	6	1	0	7
S8	2	3	1	6
S9	6	2	0	8
S10	7	2	0	9
S11	4	2	0	6
S12	5	2	0	7
S13	0	1	0	1
S14	2	2	0	4
S15	4	0	0	4
S16	1	0	0	1
Total	104	28	7	139

Table 2 shows the frequency of students' cognitive retention on the LMS. Based on the data collected from the LMS discussions, S4 displayed the highest frequency in terms of cognitive retention, contributing about 18 times of the postings, followed by S2 (17 times), S5 (16 times), S1 (15 times) and S3 (12 times). These findings prove that these five students were ready to learn in this new environment of online learning. The learning activities provided to them successfully attracted their interest and stimulated them to actively participate in the discussions. This, therefore, allowed them to process higher cognitive retention as they were able to process and retain in their memories the largest quantity of ideas and information obtained from the lesson they had learned.

Meanwhile, two students - S13 and S16 - displayed the lowest frequency of retention, with each student recording this one time in their responses. This was probably because of their less active participation on the LMS discussion forum, which constructed their low cognitive retention throughout the online learning process. For that reason, it was impossible to measure whether the students were actually cognitively retaining all the information provided during the classroom lessons.

Students were asked to reflect on the activities that had been set up by the instructors in the classroom as well as on the e-Learning LMS platform. The reflection session was conducted each week, from Week 1 until Week 4. Students could give their opinions

or feedback regarding the lesson they had learned while the instructors continuously supported the discussions with questions related to motivation. The frequency with which motivation appeared on the online discussion forum was marked as 1 for each component (Attention - 1, Relevance - 1, Confidence - 1 and Satisfaction - 1). The frequency of students' motivation on the LMS is presented in Table 3.

Table 3. Frequency of motivation on the LMS

Student ID	Components				Total
	Attention	***Relevance***	***Confidence***	***Satisfaction***	
S1	4	4	4	4	16
S2	4	4	4	4	16
S3	3	4	4	4	15
S4	4	4	4	4	16
S5	4	4	4	4	16
S6	4	4	4	4	16
S7	3	4	3	4	14
S8	0	1	1	1	3
S9	0	1	3	1	5
S10	4	4	4	4	16
S11	4	4	4	4	16
S12	4	4	4	4	16
S13	4	4	4	4	16
S14	2	2	2	2	8
S15	2	1	0	0	3
S16	2	1	1	1	5
Total	48	50	50	49	49

Table 3 shows that nine out of 16 students obtained the highest frequency of motivation level, which was 16 out of 16 components over the four weeks of the study. S1, S2, S4, S5, S6, S10, S11, S12 and S13 demonstrated all four components of ARCS motivation: Attention, Relevance, Confidence and Satisfaction. This finding was important in identifying students' levels of motivation while learning online. The results indicated that most felt motivated about the learning activities provided on the LMS.

On the other hand, S8 and S15 scored the lowest frequency of motivation on the LMS platform, with each obtaining three out of 16 over four weeks. This shows that they only responded to the reflections forum three times each over the four-week period, demonstrating their low interest in the learning activities given by the instructors via the LMS platform.

4.2 Relationship between students' motivation, students' cognitive engagement and students' cognitive retention in Learning Management System (LMS)

This study also addressed the relationship between the students' motivation and cognitive engagement on one hand, and the students' cognitive retention on the other, in

the context of the Learning Management System (LMS). This required analysis to determine the relationship between the independent variables (i.e., motivation and cognitive engagement) and the dependent variable (i.e., cognitive retention) through a decision tree analysis using data mining. To facilitate the students' learning process, the instructors outlined various learning activities and monitored the LMS discussion through the use of the IBL pedagogical method. Meanwhile, the students' comments and responses on the LMS platform were observed and analyzed accordingly.

At this stage, the students' posts on the LMS were coded and calculated based on the aspects of motivation, cognitive engagement and cognitive retention. The decision tree structure was developed using data mining software (WEKA version 3.6.6). The tree model was generated using a full dataset in the training set mode. It was constructed using a Random Tree classifier. The output shows how the classifier used the attributes to make decisions, as illustrated in Figure 1.

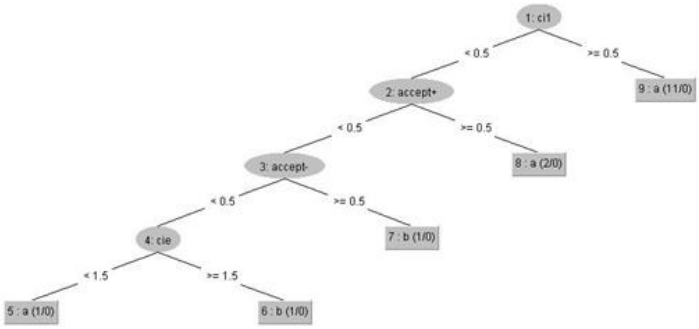

Fig. 1. Data mining decision tree analysis

The dataset was split into several attributes, with CI1 (a mechanism that allowed the students to give information with no further elaboration) at the top of the tree structure. This shows that CI1 was the highest element of cognitive engagement prompted by the students throughout the study. The decision tree also specifically shows that 11 out of the 16 students who obtained high levels of retention tended to post more statements related to CI1 on the LMS discussion forum. Another two students who achieved high retention levels were seen to provide answers with a combination of CI1 (a mechanism that allowed students to give information with no further elaboration) and ACCEPT+ (a mechanism that allowed students to show agreement with another participant and continue with some elaboration). One further student displayed a high level of retention due to responses that created a high number of CIE (a mechanism that allowed students to conclude or summarize information) on the LMS. On the other hand, one student who was inclined to provide ACCEPT+ and ACCEPT- posts and another student who

had more posts on ACCEPT- and CIE were seen to obtain low or medium retention levels.

The tree specifies that 14 students obtained high cognitive retention, two students obtained lower or medium cognitive retention and none were placed in the irrelevant group of cognitive retention in this study. Moreover, from the results of the study, one can predict the pattern or flow of cognitive engagement levels needed by the students to achieve a certain level of high cognitive retention during the LMS discussion. To conclude, a significant relationship was only observed between students' cognitive engagement and students' cognitive retention.

5 Discussion

5.1 Students' cognitive engagement, cognitive retention and motivation via the Learning Management System (LMS)

Based on Table 1, the most frequent type of engagement displayed was CHG2, which is discussed and explained in this section. Students on this course demonstrated effort by elaborating on each answer that they had given. Besides that, students also generated CIT, that is, they provided statements referring to an earlier remark or piece of information. This was somewhat related to their educational background. These students came from a languages background and were taking this course as an elective module. Students with a languages background tend to be those who talk more in class and like to argue, and they were therefore likely to act in the same way on the online discussion. These students were actively engaged in the online discussion. Whenever an instructor posted questions, most of them replied; this happened throughout the entire semester.

Furthermore, the students also generated CIE, giving statements that referred to earlier remarks or information. As stated earlier, this situation can be comprehended by knowing the nature of language students. Some students were excited to provide feedback whenever there was scope to respond to a peer's answer. Next, some students were likely to summarize the lesson that they had learned. They frequently provided explanations and summaries of points provided by the instructors. Finally, the most frequent type of engagement that students displayed was Affective (A), in which they were likely to give a positive, neutral or negative emotional reaction to another participant or a task. As mentioned, this group of students was highly expressive during discussions. The asynchronous online discussion allowed flexibility in time and space, enabling expressive, realistic and lively discussion [57].

Interestingly, there were several types of engagement that the students did not portray. They were: CHG1, NACCEPT+, NACCEPT- and RV. CHG1 refers to giving answers without explanation; NACCEPT+ and NACCEPT- are codes that refer to students not accepting the contributions of another participant with or without elaboration; while RV refers to the ability of students to plan, monitor and evaluate a task or group process. In contrast to CHG1, all the students gave answers with explanations, which was positive. They voluntarily and happily explained each answer without hesitation.

The absence of NACCEPT+ and NACCEPT- shows that the students displayed good values as they accepted all the contributions from their peers. The instructors initially expected that the students should be able to plan, monitor and evaluate the tasks by themselves; however, this did not apply to this group of students.

This study also found that the students' cognitive retention was considerably high while learning via the LMS. Hence, it can be concluded that students could achieve high cognitive retention if they display an interest in and a liking of the course they attend and put a high level of cognitive effort into most of the activities they attempt. During the discussions, the participants rarely left after their first response but continuously replied to any feedback they received from the instructors or their peers. Regarding the topic discussed, they usually offered a comprehensive explanation. This enabled the students to construct a higher knowledge of retention by critically acknowledging the meaning of the responses discussed on the forum.

The interactions that occurred clearly showed that S4 displayed her interest by replying to the feedback given by the instructors. S4 even showed a high level of cognitive engagement, since her responses critically examined the effects of not completing the analysis phase while developing an educational website. By engaging with the responses given, S4 obtained a high level of cognitive retention when learning via the LMS.

Meanwhile, the students at the low or medium levels put little effort into most topics they attempted. Once they replied, they usually ignored the following questions asked by the instructors and before mastery could be achieved. S13 and S16 displayed the lowest frequency of retention, since they only responded once to the discussion threads.

S13 replied to a discussion once in four weeks, stating her agreement with another participant's statement without contributing any further discussions. S13 not only showed her lack of interest in participating but also provided a low level of cognitive engagement response, which consequently led to a low level of cognitive retention. This was due to her failure to construct meaning from the LMS discussion threads.

S13's postings showed a higher level of cognitive engagement, in which information was given with some elaboration and the attachment of a PDF document for further reference. However, S13 failed to perceive a higher level of cognitive retention as only one response on the LMS was provided within four weeks. This was because students can only achieve a higher level of cognitive engagement if they are frequently involved in a discussion thread. Only then they can obtain a full understanding of certain topics and successfully retain that information in their memory.

In terms of student motivation, most students demonstrated all four components of ARCS motivation, which are Attention, Relevance, Confidence and Satisfaction. This indicated that most felt motivated while discussing topics online and motivated about the learning activities provided via the LMS. This might be because the students were expressive and engaged well throughout the four weeks of the study.

5.2 Relationship between students' motivation/ students' cognitive engagement and students' cognitive retention in Learning Management System (LMS)

Data mining analysis based on a Random Tree algorithm was utilized to identify the relationship between the independent and dependent variables in this study. Through this analysis, a significant relationship was identified between students' cognitive engagement and students' cognitive retention on the Learning Management System (LMS). Meanwhile, no significant relationship was observed between students' motivation and students' cognitive engagement on one hand, and students' cognitive retention on the other.

The findings indicated that 11 students who achieved a high level of cognitive retention were those who transmitted the most CI1 (i.e., any information given with no elaboration) on the LMS discussion forum. In Van der Meijden's scheme of cognitive engagement, CI1 is categorized as a low level of cognitive engagement. It seems reasonable to claim that students who merely gave information had less chance of attaining a high level of cognitive retention, but this is not always true. Even though CI1 responses only focus on giving information without elaboration, if there are numerous cases of CI1, there is a higher possibility that students would retain the knowledge they provided on the discussion forum. That is, the more students shared information with their peers from various learning sources - either internal (their own experience) or external (books, magazines, internet, etc.) - the more they might retain in their memory the knowledge and information they had gained. This was probably due to actions of sharing the details of particular concepts, which urged them to read various sources thoroughly before providing the right information on the LMS.

Another two students who obtained lower CI1 scores managed to achieve high levels of cognitive retention due to the combination of responses that were coded as ACCEPT+. This was due to the students' ability to share information that suited the purpose of the lesson, alongside knowing how to respond to other participants' statements during the online discussion. Even though they provided less information, these types of students knew how to construct their own meaning from knowledge whenever they showed their agreement through further explanation of their peers' opinions and thoughts. This demonstrated their high levels of understanding whenever information was discussed, which allowed them to retain knowledge for a long period. One student also achieved high cognitive retention due to their CIE postings, which referred to the students' ability to conclude or summarize topics they had learned. It is possible for a person to retain information in their memory if they can offer a conclusion to any information given by others. This shows they have an overall understanding of the topic they had previously discussed.

The findings indicate that even though the students provided agreement with explanation (ACCEPT+) and were able to conclude information (CIE), showing their level of understanding of the topics provided, they were still being categorized into the low- or medium-level groups. The reason was probably the frequency of postings made by both students in terms of ACCEPT+ and CIE while discussing topics on the dedicated LMS forum. Due to the lower number of ACCEPT+ and CIE postings, they were not

able to retain as much information as those who posted more often on the online discussion. Besides ACCEPT+ and CIE, they only provided ACCEPT- (accepting other participants' statements with no elaboration), which meant it was more likely for these students to obtain low or medium levels of cognitive retention. This is because the more students discuss a particular topic, the greater the probability that they will remember the lesson.

3 Conclusion

This study demonstrated that the inquiry-based learning (IBL) pedagogical method used by the instructors to develop and design learning activities successfully enhanced students' performance via a Learning Management System (LMS). The findings also indicate that the LMS is a useful learning environment for students when they learn online. The way the instructors facilitated online learning through learning design using the IBL and scaffolding strategies would help educational experts to design appropriate online courses, especially using an LMS.

4 Acknowledgment

This work was funded by the Ministry of Higher Education under Fundamental Research Grant Scheme (FRGS/1/2019/SSI09/UTM/02/4).

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Article submitted 2022-01-24. Resubmitted 2022-03-09. Final acceptance 2022-03-11. Final version published as submitted by the authors.