International Journal of Management, Finance and Accounting

Collaborative Learning Management System with Analytical Insights: A Preliminary Study

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Abstract

The mode of teaching and learning had been drastically changed over the decades. Therefore, one approach might not fit into all scenarios. Collaborative learning promotes collaboration between the students in completing given tasks with common goals. In this paper, problem statements were formed: (i) the collaboration between students and their teachers in the virtual learning environment has been at the bare minimum, (ii) the learning management system implemented has not been fully utilised with the data and information collected academically. Moreover, systematic literature review (SLR) is practised to investigate insights about collaborative learning, learning management system (LMS) and analytical approaches for student profiling. The aim of this paper is to address three research questions formed in the SLR: (i) What is the most commonly practised methodology for collaborative learning? (ii) What are the typical practised analytical methods and models for student profiling? and (iii) What factors influence students to use the learning management system? Besides, collaborative learning enables the students to conduct group discussions and assignments, promoting mutual interactions and creating knowledge amongst them. Additionally, the third-party LMS lacks synchronous chat feature. A student's profile grants educators valuable insights into the student's academic performance and learning progress. This information contributes to predicting the student's performance with the assistance of analytical approaches applied. The applied analytical approaches provide useful information about the

International Journal of Management, Finance and Accounting
Vol. 5, Issue 1 (2024) https://doi.org/10.33093/ijomfa.2024.5.1.6

Published by MMU PRESS. URL https://journals.mmupress.com/ijomfa

student's learning behaviour, allowing the teachers to take adequate action. As a result, a conceptual framework is constructed with hypotheses formulated, reflecting the relations between each construct. Besides, a dedicated collaborative learning management system with machine learning capabilities is an ideal solution, tackling students' collaboration among peers and between teachers with their academic performance and behaviour taken into account.

Keywords: Collaborative Learning, Learning Management System, Analytical Approach

Submitted on 8 November 2023; Accepted on 16 January 2024; Published on 29 February 2024.

1.0 Introduction

The modern teaching and learning inherited the fundamentals, deriving into various forms to fit different purposes and objectives with the transformation of technology (Burbules et al., 2020). Besides, there are software and applications invented to cater for a variety of functionality that positively enhance the teaching and learning process. The recent cutting-edge technology enables the invention of a beneficial application named learning management system (LMS) which manages students' profiles and records, and provides valuable information (Madiah & Mohemad, 2023).

Moreover, LMS can be utilized in various settings, promoting collaborative learning and engagement in the virtual environment. Collaborative learning promotes the development of critical thinking skills, enhances students' academic performance, fosters engagement between peers, and polishes their problem-solving skills (Laal & Ghodsi, 2012). Additionally, building a student profile with insightful components. All in all, the issues raised are (i) lack of collaboration in the virtual learning environment and (ii) unutilized acquired resources of the learning management system.

In addition, the lack of collaboration in the virtual learning environment is one of the core factors that heavily influence the student's online learning (AbuKamar &

Kamar, 2022; Sadia Shaheen et al., 2023). It formed a barrier resulting in students feeling disconnected during online classes. Besides, various third-party learning management systems were utilised as it had become a trend in conjunction with its capability of improving student performance. However, these third-party learning management systems are incapable of performing prescriptive analytics which is insightful. Lack of insightful analytics in the learning management system leads to the incapability of performing predictions and providing adequate recommendations (Susnjak et al., 2022). As a result, the data collected in the learning management system has remained unutilised. As such, the problem statements can be formed as follows: (i) the collaboration between students and their teachers in the virtual learning environment has been at the bare minimum, (ii) the learning management system implemented has not been fully utilised with the data collected academically. In terms of learning management system, the adoption of third-party software and applications is commonly practised in which the features offered are too general. The full picture of a student's well-being and performance can hardly be portrayed. As such, the inputs acquired like student's learning style, personality, academic performance and their profile particulars serve as the foundation to indicate their academic capability with the inclusion of machine learning techniques in providing their academic insights with a more in-depth understanding which is the primary objective of this study.

This paper is organized with section two as literature review, section three as methodology, section four as findings and section five as conclusion.

2.0 Literature Review

2.1 Collaborative Learning with Technology

In theory, the core factors that influence one's cognitive development and ability to learn are collaboration and interactions (Aung, 2022). Moreover, collaborative learning can also be considered as the result of the interaction between the people and the environment (Herrera-Pavo, 2021). The involvement of technology in education changes the teaching and learning approach (Børte et al., 2020). It highlighted the necessity of providing staff

with professional development and changing the teaching from content delivery to student-active learning. Additionally, the assignments designed by the teachers are leaning towards the technology-supported tasks (Su & Zou, 2022). In other words, the statement reflects that higher education institutions should promote collaboration and interaction via the utilization of technology. The balance of pedagogical and technological can be met when well-thought-out and well-designed guidelines address the difficulties and challenges faced.

Furthermore, technology plays a vital role in modern education. It allows the facilitation of a collaborative learning environment which encourages the students to communicate and cooperate with their peers which enhances their academic performance (Qureshi et al., 2021). Other than that, as technology offers new means of teaching and learning, collaborative learning is supported by technology and its course of collaboration is influenced by the features of ICT (Khan et al., 2022). In this context, ICT acts as the medium of communication, enabling collaboration among students.

2.2 Learning Management System (LMS)

The implementation and application of LMS in the virtual classroom environment, create new opportunities and approaches that promote collaboration, discussion, and interactions as well as communication amongst the students and teachers (Bradley, 2020). In the recent educational trend, the learning styles and cognitive traits., specifically, their psychological attitude towards learning (Lwande et al., 2021). However, those LMSs that are available in the current market are lacking the functionality to analyse data. Furthermore, limited internet access has always been the main obstacle that has swayed people away from continuing to use it. In addition, the user interface and user experience of the LMS design are positively affecting the favour of the students in using it. Moreover, the student's attitude towards LMS is crucial as it has a high weightage in affecting the students' intention to use LMS. As students maintain a positive attitude towards the use of LMS, the students have a higher belief that they can benefit from LMS (Al-Mamary, 2022). However, the inconsistent feature and functionality development of the LMS has the potential to lead the students to have negative impressions towards the use of LMS.

2.3 Student Profiling using Machine Learning Approach

Theoretically, a student profile is known as a profile that can usually be found and kept in educational institutions which consists of the students' particulars. With the insights provided by the students' profiles, appropriate academic-related recommendations and learning styles can be identified (Toti et al., 2021). Besides, making predictions is essential to ensure the students graduate on time and providing adequate assistance to them whenever the student is underperform, causing them at the brink of dropping out (Toti et al., 2021). Generally, the predictive approaches based on classification models faced challenges in terms of predicting one's preferences and needs. The tracking and predictions of the student's academic performance contribute to ensuring the students graduate on time (Bai et al., 2021). With the insights provided by the predictions, the teachers can address the issues that their students face easily. In addition, the machine learning approach is utilised to develop a predictive model that serves as a classifier, promoting better resource management in higher education. It helps to identify and predict student's academic success and performance (Yakubu & Abubakar, 2022).

3.0 Methodology

In this paper, systematic literature review which is also known as SLR methodology is applied. It is a structured approach that is meant for gathering and analyzing the existing research studies of specific topics of interest (García-Peñalvo, 2022). This method is commonly practised among social science researchers. In the SLR method, it uses systematic searching strategies which consist of: (1) identification, (2) screening, and (3) eligibility. The process of SLR conducted in this study is shown in Figure 1.

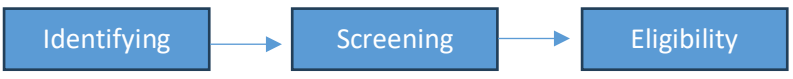

Figure 1: Systematic Literature Review (SLR) Process

In this study, the identification process is conducted in which the research questions are formed and defined. The research questions of this study are as follows:

(1) What is the most commonly practised methodology for collaborative learning?

(2) What are the typical practised analytical methods and models for student profiling?

(3) What factors influence students to use the learning management system?

To address the research questions, keywords were formed in alignment with the research questions. The keywords are as follows: (1) learning management system OR LMS, (2) collaborative learning, (3) collaborative AND learning (3) student profile OR student profiling. Next, the inclusion and exclusion criteria of the paper were then selected through a screening process. The inclusion criteria of the paper fell under the range of the year 2020 to 2022. As for the exclusion criteria, the research papers that were published before the year 2020 were excluded. Lastly, checking the eligibility of the articles helps to reduce the mismatch content which is unrelated to the current paper.

4.0 Results and Discussion

In this paper, the acquired articles are categorized into three major categories, namely: (i) Collaborative Learning in Higher Education, (ii) Learning Management System, and (iii) Student Profiling with Machine Learning.

4.1 Collaborative Learning in Higher Education

In conjunction with the recent technological development and advancement, the teaching and learning environment of higher education changed from time to time. The phenomenon is resulting in a change in teaching and learning approaches. In this paper, three case studies are chosen for observation of collaborative learning in higher education as shown in Table 1. These papers were considered in this study as the environment of

the collaborative learning conducted is aligned with the future research of this study. Collaborative learning in the virtual environment is enriched with a variety of mediums such as social media, dedicated virtual collaborative learning as well as campus-based online collaborative learning are significantly relevant to the current study which intended to focus on the collaboration between students and teachers in learning.

Table 1: Summary of Collaborative Learning in Higher Education Case Study

Sources	Environment	Methods/Approaches	Findings
Qureshi et al., 2021	Virtual	Social media engagement and collaborative learning	The study is solely focusing on social presence and its impact towards active collaborative learning.
Herrera-Pavo, 2021	Virtual	Virtual collaborative learning with developed virtual ethnography	The student groups formed in the study tend to have inconsistent performance amongst the group members when collaborating due to the nature of personalities individually, causing unresolved disagreements.
Hilliard et al., 2020	Virtual	Campus-based Online collaborative learning	The results of the study are solely depending on the students' perceptions. As a consequences, the objectives and requirements of the course might not meet its end.

4.2 Learning Management System

Learning management system is also known as LMS, is a software application developed for the purpose of tracking, reporting, and delivery of a course or learning materials from

an educational perspective. In this paper, three case studies are chosen for observation of the factors that affect students in using LMS and shown in Table 2. These papers implemented learning management system through different platforms where the environments vary from each other. In fact, there are a list of factors that can possibly affect the continuance usage of learning management system. The core factors that impact the usefulness of the learning management system are user interface and user experience design.

Table 2: Summary of Learning Management System Case Study

Sources	Platform	Factors	Findings
Alzahrani & Seth, 2021	Moodle	(1) Service quality (2) Information quality (3) Social influence (4) Prior experience (5) Satisfaction (6) Self-efficacy (7) Personal outcome expectation	The results of the study are based on only quantitative research approach. Including qualitative research approach can have a better explanation for the relationships between the constructs.
Nguyen, 2021	Blackboard Edusoft	(1) System content (2) Interactions (3) Instruction information (4) Technology quality (5) Perceived LMS usefulness (7) Perceived students' satisfaction	Blackboard and Edusoft demonstrated a somehow mediocre design as a LMS. Furthermore, the mean and medium of communication is limited. Also, users are facing difficulties in accessing materials of past semester.
Maslov et al., 2021	Moodle	(1) Technological factors (2) Emotional factors (3) Cognitive factors	The usefulness of Moodle is depending on the teachers and the nature of the course materials

4.3 Student Profiling with Analytical Approaches

Student profiling is an approach to identifying students' profiles based on their traits, characteristics and behaviour. In this paper, three case studies are chosen for observation of the analytical approaches that are commonly practised in student profiling as shown in Table 3. These papers are selected with the intention of identifying the core value given by student profiling and analytical approaches. These papers revealed the current trend and goals of implementing student profiling. The core values contributed are based on the student's academic performance assessment. With such inputs, adequate course recommendations and student's academic capabilities can be identified.

Table 3: Summary of Student Profiling with Analytical Approaches Case Study

Sources	Intentions	Approaches	Findings
Shahbazi & Byun, 2022	Course Recommendation	Natural Language Processing (NLP) and machine learning	The study solely focuses on the recommendation aspect where more analyzation and synthetization of collected data for student profiling could cover more aspects.
Embarak, 2021	Identify low-performing students	Three layers of variables	The proposed approach is effective but requires regular updates on learners' performance and has a minor impact on their privacy. The student's learning progress was not considered in the study.
Vankayalapati et al., 2021	Assess student performance	K-means algo	The strengths of K-means in grouping students based on their

performance can be considered when choosing an optimum approach to analyse students' related evaluation and assessment.

4.4 Proposed LMS Conceptual Framework

In this paper, a conceptual framework in regards to the LMS is proposed and shown in Figure 2.

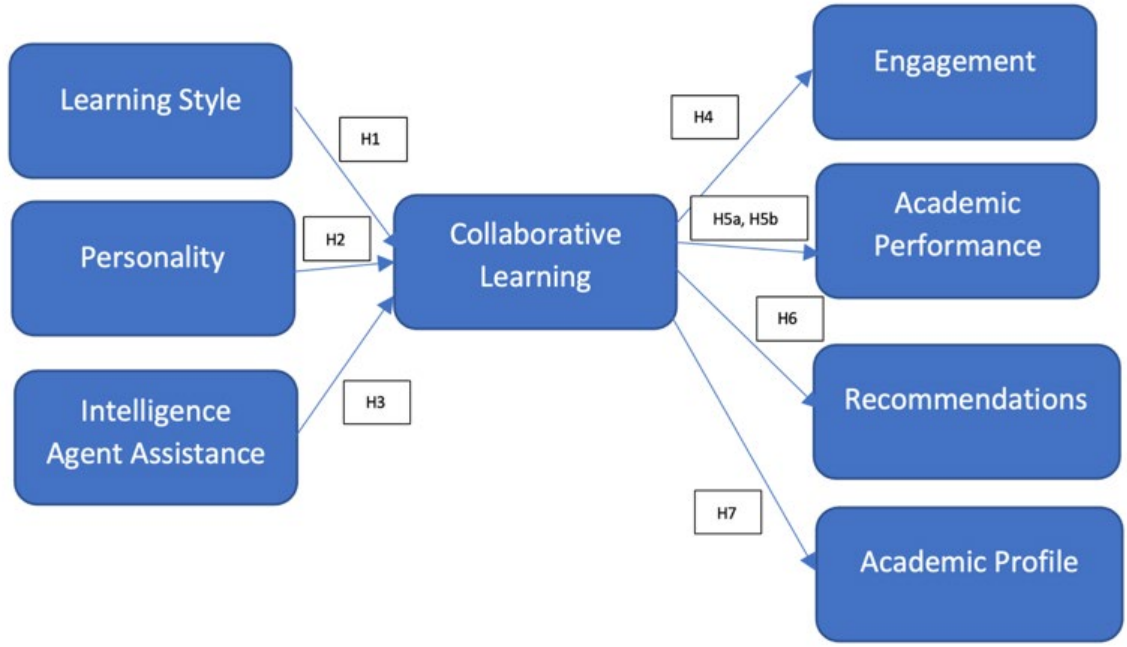

Figure 2. Proposed LMS Conceptual Framework

In Figure 2, a total of eight hypotheses are proposed as listed below:

H1: A student's learning style positively affects the student's collaborative learning experience using LMS.

H2: A student's personality positively affects the student's collaborative learning experience using LMS.

H3: Intelligence agent assistance positively affects the student's collaborative learning experience using LMS.

H4: A student's collaborative learning experience using LMS positively affects the student's engagement.

H5a: A student's collaborative learning experience using LMS positively affects the student's academic performance.

H5b: A student's collaborative learning experience using LMS accurately predicts the student's academic performance.

H6: A student's collaborative learning experience using LMS accurately predicts the student's subject-related learning recommendations.

H7: A student's collaborative learning experience using LMS accurately predicts the student's academic profile.

Developing a dedicated LMS with the considerations of the aspects and perspectives mentioned stands a high possibility and potential to elevate collaborative learning to a whole new level. At the same time, the information that the teachers acquire is put to better use by having an insightful data trend and explanation as feedback to tailor the course materials and teaching strategy accordingly.

Based on the findings in this study, the most commonly practised methodology for collaborative learning is conducted through virtual or online environments. The known trend has been a hot cake since the COVID-19 pandemic. This phenomenon reflects the growth of education nowadays is heavily related to the technology evolution. The utilisation of technology changes the nature and the mode of learning as well as how collaboration is conducted. Secondly, the typical practised analytical methods and models for student profiling are through machine learning. The machine learning approaches implemented gave acquired data and information a new meaning and definition. However, there is no best approach as the implementation of approaches relies on the use case and criteria to be met. Thirdly, the factors that influence students to use

learning management system are strongly related to the technology itself. The role of learning management system is a medium that provides a dedicated virtual environment in which students can interact. The interaction is not only limited to their peers and teachers but also the content within the learning management system. Hence, it plays a vital role in affecting the students' decision in learning management system continuance usage.

Based on the component of the proposed LMS conceptual framework, factors mentioned in literature reviews and findings were taken into consideration. The essential factors are engagement, academic performance, recommendations and academic profile. These factors serve as the fundamental in assessing and predicting a student's academic well-being. In terms of learning style, personalities and intelligence agent assistance in the proposed LMS conceptual framework, these are the proposed factors which have a possibility in changing the course of collaborative learning amongst students. These factors affect student's experience in collaborative learning dynamically. There are many possibilities to define a student and carry higher contribution compared to demographic aspects such as gender which had proven to have minimal impact in affecting student's collaborative learning.

5.0 Conclusion and Future Research

In the current paper, three aspects were covered: (i) collaborative learning in higher education, (ii) learning management system, and (iii) student profiling with analytical approaches. It has been proven that collaborative learning is beneficial to the students. However, the students might find it frustrating when paired or grouped with the other students with unbearable personalities and attitudes. Therefore, in future research, the issue might be able to be mitigated by including the student's MBTI personality into consideration to form a well-balanced group. Secondly, third-party LMS are not developed to cater for specific requirement but general tasks with alarmingly poor design. In future research, a LMS needed to be custom-designed and developed to address more criteria and maintain great extensive feature add-ons. In terms of student profiling, the data and information acquired from a student can be valuable. The student's

academic performance, learning behaviour, and even prediction of their learning progress can be done through the implementation of analytical approaches. In future research, the implementation of machine learning approaches in achieving analytics and predictions is highly recommended for more in-depth and insightful results. Taking students' academic-related characteristics and behaviour into account may further extend the research in more niche insights regarding the relationship between collaboration and academic performance. As such, a dedicated learning management system can be an ideal solution, catering for both analytical and predictions as well as student profiling as a one-stop solution.

Author Contribution Statement: The authors worked together for this paper.

Funding Statement: MMU GRA Fund of Multimedia University (MMUI/220155)

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgement: The authors gratefully acknowledge the financial support of MMU GRA Fund of Multimedia University (MMUI/220155).

Conflict of Interest Statement: Not applicable.

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