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Study of Learner's Engagement in Online Learning Environments

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Abstract. Due to a number of problems with online learning, the learners today are frequently disengaged. Among these problems, we find, for example the quality of education provided through online programs and distraction of learners in online learning, etc. So, in order to increase learner engagement in the learning process, we can build e-learning courses on a strong foundation provided by this area. With recently released papers, the major goal of this study is to give an overview that focuses on learner engagement in higher education in e-learning. The findings of the research studies cited in this article demonstrate the importance of several elements, including gamification, digital integration, learning management system (LMS) tools, etc. Furthermore, we try to propose in this work an approach to improve learner engagement in online learning environments.

Keywords: Higher Education · E-learning · Student Engagement · Engagement Type

1 Introduction

Today, young people are often disengaged, despite the provision of certain places of engagement; young people have always been mobilized, so we can say that transformations are taking place in the forms of young people's involvement. Like previous generations of students, if global issues, such as the environment, push students to mobilize, questions related to their identity or their environment affect them just as much. Thus, the various organizations dedicated to their interests allow them to grow and educate others [1].

In online learning, one of the first questions teachers have is about the quality of education provided through online programs. The most effective teachers teach students, not technology. They recognize that the problem is not the technology per se, but rather how it is applied in course design and delivery. The effectiveness of online learning depends on the teacher's planning and understanding of students needs. If the instruction is poor, students will learn less effectively.

Without the ability to engage face-to-face and without classmates who can constantly remind the students of upcoming assignments, distraction is one of the challenges of online learning. The likelihood of being distracted and losing track of deadlines is high. That's why online learning is not a good idea if students tend to procrastinate and have trouble meeting deadlines. The majority of online courses consist of endless reading followed by a long list of Multiple Choice Questions that fail to inspire students. Many students who take online training experience boredom with this type of course. And this lack of involvement and dynamism is precisely one of the main reasons for the failure of online training. Students, for example in MOOCs (Massive Open Online Courses), simply do not see the point of continuing their education, do not engage on the platform, and do not complete the course.

Low or absent student engagement is one of the major issues that arise during the online learning process. In online learning environments, they may experience behavioral engagement, cognitive engagement, or emotional engagement issues. It is believed that individualized metacognitive feedback support based on learning analytics can address student engagement issues [9]. This area provides a solid foundation on which we can build e-Learning courses, increasing learner engagement in the learning process.

There are several definitions of school engagement, as well as many meaningful statements about the characteristics that this notion encompasses. In a study conducted at the start of the high school year, [1] proposed that there are four subtypes of engagement that need to be measured separately in order to build a complete picture of student engagement. students: a) academic engagement (credit accumulation, class attendance, homework completion); b) behavioral engagement (voluntary attendance and participation in classroom activities); c) cognitive engagement (self-regulation, importance given to school, autonomy, learning strategies); and d) emotional engagement (feeling of attachment, quality of relationships with peers and teachers) [2]. And most researchers have categorized engagement into three types: behavioral, cognitive, and emotional.

In the literature, a large number of studies have examined whether computer-assisted instruction in the form of e-learning and blended learning is better than traditional face-to-face instruction. In online learning, blended learning is better than traditional face-to-face teaching in terms of student learning outcomes for example. However, comparative studies of teaching formats differ in their results, which may indicate that factors other than format alone influence learning outcomes, student retention, etc.

In this review of the literature on learner engagement in higher education, we present some research on learner engagement in online education in general. Next, we review the literature on the different formats of engagement in online teaching with traditional on-campus/face-to-face teaching and which expresses students' learning experiences in different online formats in Higher Education. Finally, we present the first elements of a new approach to improve learner engagement and we end this article with a conclusion.

2 Related works

Various studies on engagement have been carried out with elementary, secondary, and higher education students. Some studies are carried out with university students who have used the links between two models. The first model contains seven types of motivation, each of them consisting of two types of extrinsic motivation "External Motivation, Introjected External Motivation, Identified External Motivation, Embedded External Motivation, and internal motivation to knowledge, to accomplishment, to simulation, and the second model consists of three modes of engagement behavioural, cognitive, affective of the multimodal model of psychological engagement [3].

There are researches that have focused on behavioral indicators to improve learner engagement, such as the number of clicks and connections, video viewing, and posting a question or answers on the forum in a MOOC. In the case of online open courses, for example, a system is developed, which is called Learning Intervention System for MOOC edX (edX-LIS) [4, 5]. An indication of behavioral engagement is interactions between students and their peers [6]. Clicks in an e-learning environment can be used to gather data about how learners interact with the content, such as how long they spend on a page, how many links they click, how many enlarge buttons they click, and how many links to experts' advice they click. The behavioral engagement of learners was enhanced because these learning analytics data were correlated with pertinent MCQs [7].

Other researchers have studied cognitive indicators; for example, student satisfaction is an essential indicator of student success, and it is measured for example by a survey questionnaire. Satisfaction and engagement have a positive relationship with their overall performance. As well as tutor support enhances student experiences [6]. Also, the level of sharing, building, and creating knowledge is an indicator of cognitive engagement [8]. The individual's awareness and control over learning is another metacognitive indicator of cognitive engagement through Feedback messages for learner recommendation and guidance [9].

Many systems support emotional engagement in collaborative learning identify through indicators such as students' confidence in their ability to use analytics or their desire to use learning analytics to support their learning and their positive opinions on the use of Learning Analytics, such as SLACK's "Searchable Log of All Conversation and Knowledge" in student engagement in collaborative learning [11, 12]. Another emotional indicator is students' willingness to provide their data for use by students. Learning Analytics varies depending on the contexts of data use and the benefits of sharing [13, 14].

The use of Learning Analytics (LA) to boost student engagement in learning is becoming more popular in higher education environments. Some research works have shown that learning analytics (LA) systems have been created to influence student learning. For example, Moodle learning system (MEAP) deciphers the complex interactions of students and provides information for the decision-making process concerning learning and teaching, from these decisions it triggers the sending of interventions to provide advice and feedback to students on time [10, 11].

Some research works use educational games as a tool to promote learner engagement. When used in a flipped classroom, educational games can increase student engagement, resulting in better learning outcomes, and encourage critical thinking. Furthermore, gamified applications, e.g., Socrative, Quizizz, and iSpring Learn LMS, could significantly improve students' performance and engagement [23]. Game skills could not significantly influence the learning effect, but significantly increase students' engagement in the game. The feature of challenging strongly predicted the learning effect and extended learning retention [24]. Some research works are based on the LudiMoodle project of a gamified learning environment, the system can generate (directly involves teachers in the adaptation process) a new game element recommendation to re-engage learners [25].

Some studies are based on quantitative data with a qualitative component to supplement the data collected. Based on the CEG Learning Design Framework, researchers [26]. have studied how learning analytics could help to evaluate program delivery. This research discusses the importance of evaluating the success of e-learning programs by analyzing learning analytics and student feedback in the overall instructional context and program design. Quantitative research explored student engagement with online activities that promoted low-level cognitive skills (i.e., watching videos, reading materials, and listening to podcasts) as well as high-level cognitive skills (i.e., participating in online forums and webinars) [26].

Other researchers use WEKA (Waikato Environment for Knowledge Analysis), which is a toolkit used for machine learning and data mining. WEKA (Waikato Environment for Knowledge Analysis) was used to run the K-means algorithm to group students into different engagement level groups [27].

This literature review focused on the factors that enhance learner engagement in online and blended learning in higher education. Studies show that blended or online learning courses should be designed to promote consistency between online and offline activities, and between campus-related and practice-related

activities. Student engagement in blended or online learning methodologies is significantly impacted by the roles and interactions between educators. According to research, students' learning experiences in online or hybrid courses are influenced by a number of different elements. According to the literature review, factors that affect students' learning outcomes and participation in higher education are a major focus of educational research. To learn more about the variables that are most likely to affect students' participation in online learning, more research is necessary.

The majority of research works cited previously are presented in table 1.

Table 1: Summary table on learner engagement in higher education.

Title	Categories	Engagement			Techniques & Methods	Type
		Behavioral	Cognitive	Emotional		
Self-determination theory and a multimodal model of engagement: a promising pairing to better understand the links between academic motivation and engagement in university students [3]	University students	X	X	X	Self-report questionnaire with 188 university students	in-class
Applying learning analytics for improving students engagement and learning outcomes in MOOCs enabled collaborative programming courses [4]	University students	X	X		<ul style="list-style-type: none"> - Recording of clicks during learning activities. - Video viewer - Publication of a question or an answer on the forum. - Intervention strategy 	Online

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Table 1 – continued from previous page

Title	Categories	Engagement	Techniques & Methods	Type
Improving learner engagement in MOOCs using a learning intervention system: A research study in engineering education [5]	University students	X	- Intervention strategy	Online
Learner satisfaction, engagement and performances in an online module: Implications for institutional e-learning policy [6]	University students	X	- Recording of clicks during learning activities. - Survey questionnaire	Online
Click-level learning analytics in an online medical education learning platform [7]	University students	X	- Acquired clicks of online learning environment	Online
Effect of three network visualizations on students' socialcognitive engagement in online discussions [8]	University students	X	- Use of the SLA tool (social learning analysis)	Online
Learning analytics intervention improves students engagement in online learning [9]	University students	X	- Intervention strategy	Online
An enhanced learning analytics plugin for Moodle: student engagement and personalised intervention [10]	University students	X	- Intervention strategy	Online

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Table 1 – continued from previous page

Title	Categories	Engagement	Techniques & Methods	Type
Expectations for supporting student engagement with learning analytics: An academic path perspective [11]	University students	X	<ul style="list-style-type: none"> - Recording of clicks during learning activities. - Intervention strategy 	Online
Learning analytics in collaborative learning supported by Slack: From the perspective of engagement [12]	University students	X	<ul style="list-style-type: none"> - Online survey 	Online
Does Blended Learning Enhance Student Engagement? Evidence from Higher Education [15]	University students	X	<ul style="list-style-type: none"> - Interviews with focus groups - Student surveys. - LMS registration 	Blended
The important elements of LMS design that affect user engagement with e-learning tools within LMSs in the higher education sector [16]	University students	X	<ul style="list-style-type: none"> - Semi-structured interviews about Blackboard 	Blended

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Title	Categories	Engagement	Techniques & Methods	Type
A Literature Review of the Factors Influencing E-Learning and Blended Learning in Relation to Learning Outcome, Student Satisfaction and Engagement [17]	University students		- Database-based review of systematic research conducted in January 2017 and includes 44 peer-reviewed articles and papers published between 2014 and 2017.	Blended
Blended learning: how can we optimize undergraduate student engagement? [18]	Secondary education	X	- Use of a BLEnDT tool for blended learning in different areas (psychomotor, cognitive, and affective). - Two online courses	Blended
Gamification Approach in Education to Increase Learning Engagement [19]	University students	X	Literature survey of 30 higher education students	Blended
Digital literacy in higher education: A case study of student engagement with e-tutorials using blended learning [20]	University students	X	Online survey	Blended

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Table 1 – continued from previous page

Title	Categories	Engagement	Techniques & Methods	Type
Digital for FLE online co-learning: from personal engagement to professional development [21]	University students	X	Online survey	Online
An interactive gamification solution for a formative assessment system [23]	University students	X	Formative quizzes, post-questionnaire surveys, and personal interviews	Online
The effect of educational games on learning outcomes, student motivation, engagement, and satisfaction [24]	University students	X	Based on the inclusion criteria, selected publications in peer-reviewed journals and provided a brief overview of the evidence found.	Online

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Table 1 – continued from previous page

Title	Categories	Engagement	Techniques & Methods	Type
Dynamic gamification adaptation framework based on engagement detection through learning analytics [25]	University students	X	Initial static adaptation based on learner profiles is used, then dynamic adaptation is used to improve initial static adaptation recommendations using learning analytics.	Online
Assessing Student Engagement in Online Programmes: Using Learning Design and Learning Analytics [26]	University students	X	Evaluating learning analytics and student feedback in the context of the program's broader pedagogical design.	Online
Student engagement level in an e-learning environment: Clustering using k-means [27]	University students	X	Using machine learning (K-means algorithm to cluster students based on 12 engagement metrics).	Online

2.1 Discussions of Related Works: Findings and Insights

In this section, we discuss the related works summarized in Table 1 through different points: (1) Domains used (Section 2.1.1); (2) Problems and solutions (Section 2.1.2).

2.1.1. Domains used Figure 1 shows the domains considered in this paper. From the works reviewed, we have drawn four domains:

- Pedagogical intervention strategy (to assist learners) in human learning environments.
- Use of learning analytics through systems developed to support learner engagement.
- Use of learning analytics through systems developed to support learner engagement.
- Works using educational games.

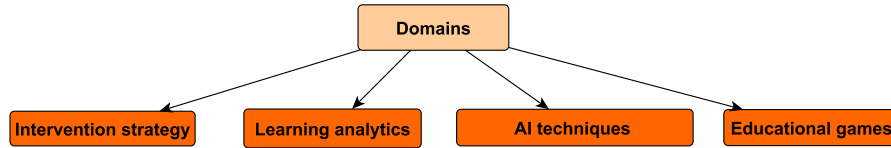


Fig. 1. Domains of research reviewed.

2.1.2. Problems and solutions We have drawn the following problems from the works reviewed and propose some solutions for some of them:

- Lack of student demographic data: This does not allow us to conduct a qualitative analysis of the data based on demographic parameters such as gender, education level, and ethnicity. In addition, the topics covered in the course were not identified. This was done to ensure the complete anonymity of the dataset following the university’s request. In addition, the dataset did not offer any information about the content of the assignments, the content of the forum posts, or the course content. Therefore, only a quantitative data analysis process is performed in an attempt to assess student engagement in the course. Additionally, due to the structure of the LMS (Learning Management System) used for the initial collection of the event log dataset, it was not possible to measure time spent at the course platform because the system does not record movement from one platform to another. Therefore, the time students spent at the platform could not be accurately measured. Therefore, to better assess student engagement, the total time spent on the

course as well as the average time per session should be collected and accounted for. This should be integrated into the university's LMS (Learning Management System) to record the times when students log into the course and when they leave. This would also allow instructors to identify unengaged students in the early stages of the course rather than having to wait for a later stage. Another idea to explore is the impact of the considered engagement metrics on student performance. The relationship between the metrics and the grades that students earn can be studied to better understand the importance of each metric on overall student performance.

- Student engagement is a complex issue that also depends on factors such as teaching experience, course design, teaching style, and course concepts. These factors need to be further investigated in the context of student engagement. In addition, some studies have mainly adopted content analysis without statistical support, which may reduce the reliability of the results. Hence, we plan to evaluate the total number of student clicks for each assessment, course design, teaching experience, and teaching style in an open online course, and then use collaborative filtering to recommend materials and lectures for low-engagement students. This will help students achieve higher scores on the final exam.
- Educational games could be used not only to impart knowledge but also to assess knowledge acquisition. They should highlight learning analytics and data mining techniques of educational game-based learning and try to find solutions to solve various problems to improve the effectiveness of educational games. The learning results, student motivation, engagement, and pleasure in game-based learning could all be improved by designers and educators.

We have presented a literature review about learner engagement. We have observed that each research has its own focus on indicators of the dimensions of engagement. Furthermore, the majority of the studied works focus on the use of learning analytics. Some of them use AI (artificial intelligence) techniques, and this is explicit. But, this work aims to improve student engagement by using the traces to help students improve their engagement through automatic recommendations.

So, from the digital traces left by the learners, we could first generate dashboards intended to support their self-regulation, then the possibility of dialoguing with those learners who would be in the process of disengagement. Research can be conducted for different courses on self-reflective (self-regulated) learning skills to improve student engagement.

3 Proposal of an approach to improve learner engagement

In this section, we present our proposal concerning a new approach to improve learner engagement in an online collaborative environment. This approach is based on collaborative learning. The latter is a method of learning that involves a group of students working together to achieve a common goal (e.g. to solve

a problem, complete a challenge, answer a question or share knowledge). Furthermore, this approach supports the positive relationship of interdependence between students, i.e. often encourages positive interactions and collaborations, such as The Seeing, The Voice, The Listening and The Notice through chat rooms, discussion forums, and online conferences.

Students are challenged to increase their engagement through collaboration. When students feel like they are heard and their ideas and thoughts are valued as they study, so their motivation and engagement increase.

In e-learning platforms, learning activities can be effectively assessed through online courses to increase learner engagement using traces.

The proposed approach illustrated in Figure 2 should meet the following goals:

1. Build a performance-based model for each learner in the learning environment.
2. Calculate the learner's engagement using the traces available in the built model.
3. Evaluate a set of advice/recommendations for each learner to improve their engagement on time.

In this approach, we collect the learners traces from the learner model, which can be updated at any activity of the learner. Then, the learner models are stored in the "Learner Model Database" and used by other modules. The "Engagement Calculation Module" calculates the engagement for each learner in order to assess his status in real time. If disengagements are detected, it sends a message to the "Recommendations Module". The latter will intervene with the learner and take appropriate action. This module provides learners with suggestions to help them in their learning.

3.1 Behavioral Module

The behavioral module analyzes the learner's behavioral actions such as access actions, consultation actions, and social actions (chatting with other learners, sharing class progress, etc.). These actions are connecting to the platform, accessing the forum, messaging, chatting, asking questions, sending or answering a question, consulting publications posted and shared by the learner, messages sent and answered by the learner, and consulting or downloading educational resources. The latter refreshes on the learner's model.

3.2 Cognitive module

The cognitive module analyzes the actions left by the learner when performing self-assessments, e.g. the completion of the MCQ (Multiple Choice Questions), the number of exercises performed, etc. It stores these actions in the learner's model.

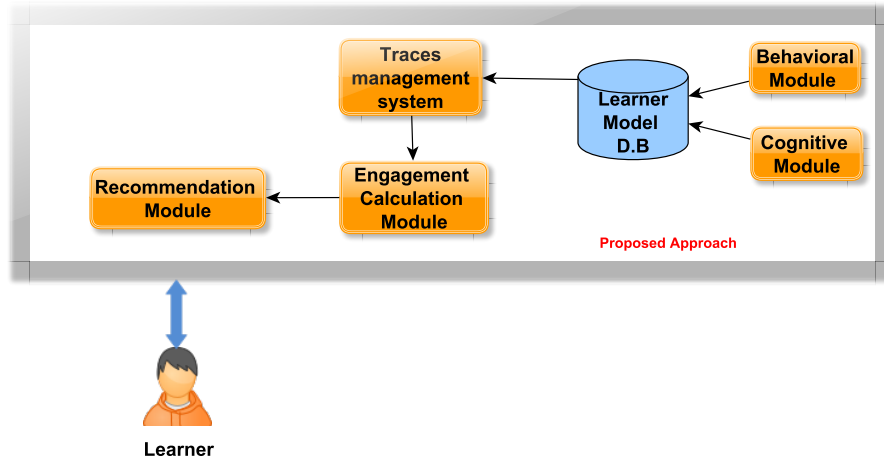


Fig. 2. General Architecture of the system adopting the proposed approach.

3.3 Traces management system

Through this module, the system analyzes these traces as Sassi and Laroussi [22] say, "the follow-up of the learner's training is a fundamental element of distance learning, which proposed the analysis of the learner's traces by a platform". The traces are organized with the help of a module, a program running in the background that filters and organizes the traces according to simple principles to complete the learner's profile. An overview of the actor's activity is provided in the profile that has been developed [22]. Then, this module sends these traces to the engagement calculation module to calculate the level of engagement.

3.4 Engagement Calculation Module

The learner consults, for example, the educational resources (video, course text, illustrative image, etc.), thus, he participates in communication activities (Communication by messaging, Communication by the forum, etc.). At this point, the engagement calculation module begins to calculate the behavioral engagement percentage for each learner.

For testing his acquisition of the knowledge of the courses, the learner passes the self-assessment exercise, when he answers the questions of the exercises. At this point, the engagement calculation module begins to calculate the percentage of cognitive engagement for each learner for each exercise. If the percentage of learner engagement (behavioral or cognitive) is high, then he will be considered more engaged. Otherwise, if the learners engagement percentage is low, then he will be considered unengaged. In the latter case, this module sends this difficulty to the recommendation module.

3.5 Recommendation Module

This module receives the difficulty detected by the engagement calculation module, and therefore it displays automatic advice (recommendations) to the learner to improve it according to the type of engagement. If the advice/recommendation is helpful, then this module can consider it and evaluate it as a useful recommendation. If it is not, this recommendation is evaluated as useless and so the next advice/recommendation is displayed. The process continues until the difficulty is marked as resolved.

4 Conclusion

This literature review focused on factors that enhance learner engagement in online and blended learning in higher education. Thus, studies reveal that blended or online learning courses should be designed to promote consistency between online and offline activities, and between campus-related and practice-related activities. Regarding the roles and relationships between educators, they have a significant influence on student engagement in blended or online learning strategies.

This literature contains works where each one has its own objective according to the indicators of the dimensions of engagement. Therefore we want to extract the most relevant indicators and the suggestion of new indicators in order to measure the engagement of the learners and improve it by using learning analytics techniques to help students improve their engagement using advices and recommendations. We can ensure that recommendation messages are sent automatically which are widely accepted and effective for the learners. Therefore, feedback based on learning analytics should be designed, and we must identify what should be included in the content and nature of feedback from one side, and from the other side what learning analytics parameters should be included. This will help to develop the idea of a student-centered analysis of learning.

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