

Is Learning Analytics the Future of Online Education?

Assessing Student Engagement and Academic Performance in the Online Learning Environment

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Abstract—Educational structures have been evolving, that even so rapidly with the revolution of information technology and the internet. Recent pandemic and its aftereffects are still looming over the globe, posing a challenge and an opportunity for educators. Online education was one such innovation, which has changed the dynamics of education around the world. The purpose of the paper is three-fold, first, to assess the levels of student engagement in the online learning environment, second, to examine how student engagement is related to their academic performance using learning analytic tools and third, to propose an integrated learning analytics framework. The study used, an exploratory research method, and the data was collected from multiple sources; LMS Logs, self-administered questionnaires from students, and interviews with the instructor. The study was conducted at a course level in a private university. The finding suggests a positive relationship between student engagement and their academic performance and advocates the application of an analytics plug-in on LMS which supported instructors in identifying students at risk and providing them with real-time feedback aiming to improve their performance. The study provides insights into the field of online learning and offers evidence-based recommendations to educators. The utilization of Learning Analytics to examine student engagement and understanding of how students learn would contribute to the development of learning theories and to designing an appropriate digital learning environment that supports and improves their learning.

Keywords—student engagement, Learning Analytics (LA), higher education, online learning, Learning Management System (LMS), e-Learning

1 Introduction

The 21st century saw the worst pandemic, with the outbreak of Covid-19, which consecutively hampered all possible human activities and personal and professional working environments were moved to an online mode to stop the contagion of the virus. By now, it is acknowledged that technology has proven to be a great enabler of transformation in many fields; ranging from supply chain management, marketing, and finance to project management. With the advancement of e-learning and the use

of online platforms, the collection, analysis, and visualization of data in the current learning context pose a challenge to educators [1]. The solution can be found in the appropriate application of Education Data Analytics. The application of data analytics technology requires resources as well as commitment from all stakeholders [2]. Educational data analytics can be applied at three levels: learning analytics, teaching analytics, and institutional analytics. The first among them, Learning analytics (LA) is an evolving discipline concerned with the “measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environment in which it occurs” [3]. Given the challenges of online education, if data analytics technology is used appropriately, it can play a pivotal role in revolutionizing the way instructors and institutions evaluate the learning experience of students.

In addition, past studies suggest that one of the biggest challenges in online learning faced by students and teachers alike is the low levels of engagement [4]. Therefore, it becomes imperative to utilize learning analytics not only as an assessment tool but as an instrument that would enhance student engagement and provide them with continuous feedback on their performance. The paper deliberates on the importance of assessing the usefulness of learning analytics to enhance student engagement and academic success.

Another challenge as recent studies have also analyzed is the impact of Covid-19 on the physical and mental health of students and teachers. The psychological distress created by the Covid-19 scenario has led to burnout and depression among teachers and students [5]. Therefore, motivating students and keeping them engaged in an online class environment has been proved as a challenge. One of the critical areas to be addressed is the engagement of students as many distractions exist in the online environment. Since it is recognized that a high level of student engagement leads to higher performance, the question is how can we improve the engagement levels for achieving greater performance and accomplishing overall learning goals, particularly in the online environment. Many studies have recommended the application of learning analytics in higher education, however, there is a dearth of integrated frameworks available for a holistic application for online teaching and learning mediums. In addition, according to Huang & Wang [6], there is a lack of research studies examining the relationship between student engagement and academic achievement, in online educational practices.

Therefore, to fill the aforementioned research gaps, the current study advances further in this area and examines the application of LA tools to enhance student engagement and ultimately their academic performance. The present study focuses on the following research objectives:

1. Examine student engagement in an online learning environment
2. Assess the connection between student engagement in online courses and their academic performance
3. Propose an Integrated framework of learning analytics.

Following the objectives, the study explores how much engaged and satisfied students are in the online environment, and how students’ engagement is related to their academic performances. In addition, how technology in the form of learning analytics

has helped instructors to enhance their teaching, assessment, and feedback. Towards the end of the paper, an integrated framework of learning analytics is proposed which provides the practical approach to implementing learning analytics to enhance student engagement, leading to better academic performances.

This section has introduced the study and the remainder of this paper is structured in the following sections; the next section provides a summary of related work, the research methodology is presented in section three, the fourth section combines findings and section five provides a discussion, section six is devoted to the description of the proposed integrated framework. The last section concludes the paper with some practical and policy implications, limitations of the current study, and research gaps for future areas of study.

2 Related work

This section of the paper provides a brief background of relevant works and studies conducted on the subject. The subsections below explain the related work in the field of student engagement, the relationship between it and academic performance, and learning analytics.

2.1 Student engagement

The recent Covid-19 pandemic led to an emergency transition from traditional to online teaching in the higher education sector around the world. This transition has been challenging for many, for teachers, school administrators [7], and particularly for students as they felt isolated and detached while studying online. Though student engagement is not a new concept, it is becoming more important than ever in online learning environments. Any student is said to be engaged in any course, task or assignment when he or she is fully involved and demonstrates active participation with learning material and activities. More precisely students' motivation and active learning define their engagement levels and commitment to learning.

Student engagement is a complex and multifaced concept that can be analyzed on different levels; cognitive, affective, and behavioral [8]. Past studies suggest that there is no consensus on a particular definition of student engagement, therefore for clarity purposes, in the current study we will use the definition given by Balwant that, [9] Student engagement is represented as "highly activated and pleasurable, emotional, behavioral and cognitive involvement in academic activities." Behavioral engagement can be seen during active participation in class activities, discussions, and assignments. While cognitive engagement refers to the conscious efforts invested by the student in their academic work (active learning) while affective engagement presents the student's liking and emotional reactions towards the coursework.

Since motivation is crucial, past studies have examined the application of motivation theory and self-determination theory to explain student engagement. Particularly in the online learning environment as Chiu, [10] examined how the psychological need for self-determination affects engagement in school students. The study found that perceived autonomy, relatedness, and competency are significantly related to student engagement.

Considering the European context, many studies have assessed the role of technology in enhancing learning and engagement among students in higher education. According to Serrano et al., [11] technology and digital skills are considered urgent by the European Commission (EC). Their study used blended learning which was found to be instrumental in increasing student engagement in online as well as the in-class environment.

Student engagement can be achieved through various techniques in a face-to-face (F-2-F) class structure [12], however, the online environment poses many challenges, especially when the instructors are not able to gauge the body language and see the learners F-2-F. Consequently, studies are being conducted on effective online teaching strategies that enhance student engagement and participation [13]. An important predictor of this is the situational factors that can vary from student to student. Moreover, appropriate utilization of activities on the Learning Management System (LMS) and instructor feedback play an important role in creating an engaging online learning environment. A recent study by Domina et al., [14] examined the factors that predict student engagement in remote learning and found that technological resources like access to high-speed internet and electronic devices, promote it. In addition, the instructional techniques and regular communication between parents and schools and social capital were found to be important predictors of student engagement in remote learning during the period of Covid-19. Therefore, past studies have established student engagement as crucial in the online learning environment.

2.2 Student engagement and academic performance

Traditionally, in the on-campus, face-to-face classes students who were involved and engaged in course-related activities performed better in academics. Studies have examined the relationship between student participation and educational achievement among students and concluded that there is a strong correlation between these two variables. However, in the online learning scenario, achieving student engagement is difficult for the instructors as well as students due to several limitations [15]. For example, a feeling of physical and emotional disconnection in online classes, anxiety, stress, and exceptional demand for online courses particularly during the CoViD-19 pandemic. Another study confirmed that during the pandemic students' motivation and engagement were affected in the online classes which eventually decreased their learning as well as academic performance [16]. However, paradoxically some studies have also found that students perform better in an online environment than compared to a traditional classroom environment [17].

Past studies have established a connection between student participation, engagement, and academic performance [18], [19]. Hence, student engagement has been considered a key factor that influences not only their preferences regarding the study mode but also enhances their learning and performance [20]. Another study has found an enhancement in students' learning and performance with more participation in online activities. The study compared two student groups and their engagement and performance levels. The group of students who were involved and engaged in the course via a blended learning approach outperformed the other group [21]. It is self-evident that applying appropriate theories and techniques in the teaching pedagogy would enhance

student involvement and participation in online courses, which will lead to higher levels of learning and academic performance.

However, few studies have also shown inconclusive results on the connection between students' online engagement and their performance [22]. There can be other factors that can influence students' performance like socioeconomic status, age, or gender [23]. In addition, during the pandemic health emergency and Covid-19 lockdowns, factors such as the socio-economic background of students, data accessibility, and demographic difficulties, have created a digital divide, and consecutively, differences in academic performance have been witnessed in past studies [24]. Though a majority of the studies have found a positive relationship between engagement and performance, it can be concluded that student engagement is one of the factors that influence academic performance in the online learning environment. This can be further expanded by answering the next question; how do LA tools help solve this issue?

2.3 Learning Analytics (LA)

After establishing the paramount relation between student engagement and academic performance, the next section discusses, Learning Analytics (LA) for better navigation of the strategies. While the initial work on LA, has been focusing on studying retention and drop-out among students, later it got advanced to the prediction and forecasting of student performance and improving learning strategies [25]. According to Siemens [26], LA can exist at the micro level (course, program) or macro level (university or region). The predictive models under learning analytics can help identify and notify students at risk [27], establish relationships between learner engagement and learning outcome, and most importantly provide real-time feedback.

The adoption and effectiveness of LA have been studied in higher education institutions around the world, for example, Colvin et al., [28] examined the Australian universities (40) for LA adoption and found that one group of institutions has applied, LA for student retention while the other group uses LA in a more advanced fashion to improve teaching and learning in the institutes. Meanwhile, in European higher education institutes, the SHEILA project (Supporting Higher Education to Integrate Learning Analytics) reported the implementation of learning analytics in a few institutes. The SHEILA project was conducted across 22 countries during 2016–2018 and concluded with a context-specific framework for sustainable implementation of LA [29]. Another study by Kim et al., [30] examined the application of LA to support self-regulated learning in the online environment of the South Korean University. A recent study focused on the evaluation of learning analytics at Latin American universities which presented three cases of institutes that have applied LA effectively to assist academic advisors and teachers [31]. All the examples stated above give substance to the value of the application of technology through LA.

Moreover, for incorporating technology and digitization of courses the role of the leader is imperative. A recent study has found that digital leadership roles include, a leader's understanding of digital culture and the functioning of technology, perceived as critical by educators. With that the leaders must demonstrate their active support in developing a digital learning culture in schools, the study concludes [32].

Focusing on the synergies between learning analytics and learning design, Holmes et al., [33] surveyed nearly fifty thousand students, their behavioral outcomes, and satisfaction measures. The study found that the application of LA for learning design can contribute to enhancing learning in an online environment. Another study presented evidence of improved teaching outcomes with the application of an advanced predictive learning analytic system used by 559 instructors of an open university in the United Kingdom [34]. The study found that teachers who made average use of this system led to better performances in their students. Moreover, in a recent study by Kollom et al., [35], the effectiveness of LA was explored in a cross-case analysis from four European universities (Spain, Estonia, Netherlands, UK). The study found a common challenge in all these cases; though the academic staff understood the importance of LA as a tool they lack the commitment and onus to act based on the findings of the analysis. This is conducive to demonstrating the importance of engaging the academic staff in the policy formation and implementation of LA.

LMS log data has been used in past studies to predict students' academic performance. Logs for frequency of login, participation in forum discussions, a post created and viewed, etc. have been assessed to predict student performance [36]. However, capturing only LMS data via LA is not sufficient, the instructional interventions are equally important to make informed decisions. Though it has been a decade since LA strategies are being studied seriously, however, the actual application and outcomes are yet to be explored universally and there are still some gaps that remain to be considered. Therefore, an integrated framework is proposed to be reviewed, for a holistic application of learning analytics.

3 Method

Discussions on the application and strategies of LA must follow a description of the methods used for this study. Based on the study of relevant papers published in recent years, particularly after CoViD-19, the current research emphasizes objectives which are: 1) To examine student engagement in an online learning environment, 2) to assess the relationship of student engagement with academic performance using LA and 3) to propose an integrated framework.

To achieve these aforementioned objectives, the study used an exploratory research method, and the data was collected from multiple sources; LMS Logs, self-administered questionnaires from students, and interviews with the instructor. The study was conducted at a course level (as per Siemens) applying a mixed-method approach. In addition, a sample of LMS activities was analyzed for student participation, engagement and performance. All the data was collected towards the end of the semester and logs were retrieved from LMA for the complete semester.

To assess and evaluate student engagement, a survey questionnaire was used and students' perceptions and experiences were recorded in these self-report surveys. The survey questionnaire was adapted from the past study by Lin et al., [37] for measuring student engagement on a five-point Likert scale. It was divided into three sections: the first section collected background information from the respondents, the second

section measured the student's cognitive engagement, and the third section assessed their emotional engagement. The survey was completed by students taking a business course at a private university in Saudi Arabia. Out of 110 students taking the course, 102 duly completed the survey which could be used for further analysis. Ensuring ethical standards, no personal data was revealed as all the data was anonymized.

Data were analyzed with the SPSS 22 and descriptive statistics, like mean and standard deviation are used for analyzing the survey results. The reliability was calculated and Cronbach's alpha coefficient is calculated to be 0.8, (considered satisfactory).

Finally, the viewpoints of the instructor who applied LA tools were also incorporated into the study. The interview with the instructor lasted for an hour and it included a demonstration of a few LA tools as well. The questions were asked about student engagement, the use of LA tools, and the benefits and challenges observed in the online learning environment.

For assessing student learning and academic performance, their participation was examined through learning analytic tools, and grades were used for three different assessments/exams. After every assessment, the instructor provided individual feedback to the students on their participation and performance.

In the next section, results, and findings related to student engagement, academic performance, and learning analytics are presented.

4 Results and findings

The next stage of the study is to present the most significant part, that is the result which proves very insightful. The finding suggests a direct connection between student engagement in activities recorded on LMS and their academic performance. Table 1 presents the descriptive statistics for Cognitive engagement, Emotional engagement, and Student satisfaction with the course. Students' cognitive engagement was assessed through seven items. The table shows that the highest engagement was recorded for two items "were you able to relate it to what you already know?" with a score of 4.52 out of 5 and "how well were you concentrated?" with a score of 4.68 out of 5. Students reported their cognitive engagement to be moderate to high, while emotional engagement had higher mean scores.

The emotional engagement was assessed through nine items and the highest score was recorded for the item "were these activities interesting?" with a score of 4.87 out of 5. Similarly, "do you like to participate in these activities on LMS?" has a score of 4.67 out of 5. The overall satisfaction was also recorded high (87%) with a score of 4.36 out of 5. However, for a few items the score was not very satisfactory for example, 'Did you set a goal for yourself prior to the LMS activity?' scored 3.35 out of 5. The low score depicts that the students were not goal oriented and confident about their plans. For the remaining items, the scores were above 70%. As per the statistical results of the survey, students were satisfied with the timing and quality of feedback provided by the instructor in this online course. Therefore, the overall student engagement was found to be 4.11 out of 5 (82%).

Table 1. Descriptive statistics of variable

Engagement and Satisfaction	Indicator (Online Learning Experience)	Avg	%	Std. Dev
Cognitive Engagement	Were you learning anything or getting better at something?	4.39	87.8	0.978
Cognitive Engagement	How important was it to your future goals?	3.73	74.6	1.186
Cognitive Engagement	Were you able to relate it to what you already know?	4.52	90.4	0.831
Cognitive Engagement	How well were you concentrating?	4.68	93.6	0.711
Cognitive Engagement	Did you set a goal for yourself prior to the LMS activity?	3.35	67	1.429
Cognitive Engagement	How challenging were the activities on LMS?	4.32	86	1.249
Cognitive Engagement	Was it important to you?	4.27	85.4	1.067
Emotional Engagement	Did you feel good about yourself?	4.13	82.6	1.274
Emotional Engagement	Do you like to participate in these activities on LMS	4.67	93.4	1.130
Emotional Engagement	Did you experience frustration?	2.12	42.4	1.300
Emotional Engagement	Did you feel socially connected to anybody during this learning activity?	4.34	86.8	1.418
Emotional Engagement	Did you wish you had been doing something else?	3.12	62.4	1.475
Emotional Engagement	Were these activities interesting?	4.87	97.4	0.927
Emotional Engagement	I think we can learn more by being active on LMS and participating in the activities	4.10	82	0.908
Emotional Engagement	I would like to have similar activities in the next term and also	4.53	90.6	1.049
Emotional Engagement	Did you enjoy the LMS activities?	4.67	93.4	1.234
Overall Satisfaction with Instructor's feedback	How much are you satisfied with the timing and quality of feedback provided by your instructor?	4.36	87.2	0.978

As student engagement was found to be satisfactory in this course, the next step was to assess its relevance to academic performance. For this, LMS logs and grades were retrieved and analyzed. According to these statistics, several graphical figures below depict the online participation and engagement of students. Figure 1 presents the distribution of logs by the final grade students attained in a course at the end of the semester. It can be seen from the figure that there is a direct connection between the number of logs and the student's grades for example the students with the highest grades had the highest number of logs. However, this analysis is superficial and there is a need to dig deep and analyze the associations between different activities on LMS and learning outcomes.

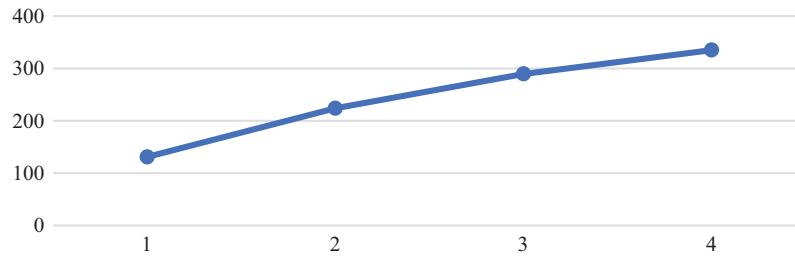


Fig. 1. Frequency of logs by grades

To check the participation and engagement in various activities, LMS logs were retrieved for each activity. Figure 2 depicts the level of student engagement for activities on LMS. It is observed that students actively participated in all online activities with the highest engagement in forum discussions. It was the most informative and insightful activity studied on LMS. The figure shows a direct relationship between student participation in these activities with their final grades. The findings suggest that students from this generation are tech-savvy and are inclined towards the usage of a variety of online activities available on LMS.

For more clarity, a comparative grades figure was retrieved. Figure 3 presents the student's achievement in terms of grades received at three points time in the semester. The first assessment was done in week 4 with an online quiz and the results are depicted in blue color in the figure below. After the first assessment instructor applied interventions in the teaching pedagogy and provided feedback to students who were at risk. With the application of the LA plugin on LMS, students at risk could be identified through digital traces reflecting less engagement and participation. The second assessment was done in week 8 with the midterm examination, and the last assessment was done in week 12. The regular and timely feedback to students led to an increase in the performance of three at-risk students. Further, feedback was provided after midterm grades and a considerable change was recorded in the final results of five students (Number 5, 9, 11, 23, and 26). Many other observations were also recorded for the engagement levels and performance of students.

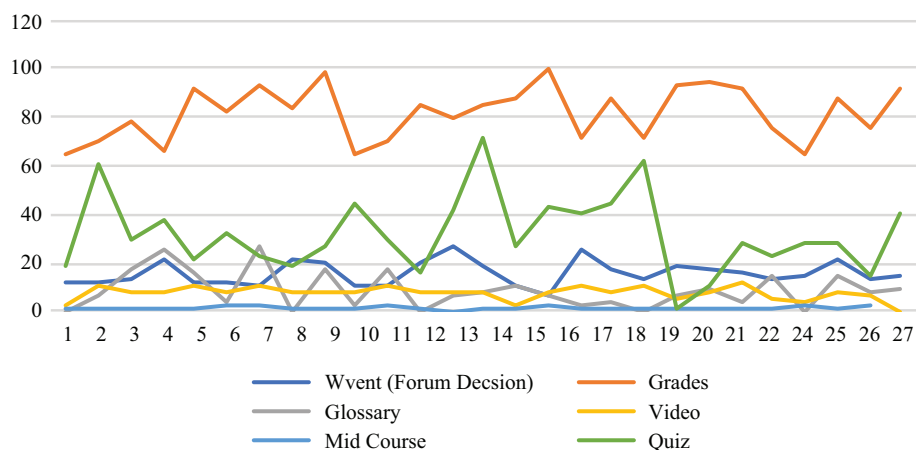


Fig. 2. Comparative analysis of LMS activities

To supplement the findings from the survey and LMS records, an interview was conducted with the course instructor who applied LA tools and implemented interventions in the middle of the course to enhance the academic performance of students. It was mentioned in the interview that the instructor used plug-in analytics on the LMS system to predict the student’s performance and therefore, provided continuous interventions, personalized feedback, and advice through emails. The instructor mentioned:

“...the analytics plug-in available on LMS has supported us in identifying student participation in all activities and to intervene if required...”

Some of the interventions mentioned in the interview were; the addition of pictographic and video explanations of concepts, changes in the usual lesson plan; positive rewards; being more flexible and empathetic, and using games/activities as energizers in the middle of the session. Moreover, direct actions were taken through personalized emails sent to students at risk at regular intervals. As depicted in Figure 3, a few students did not perform well in their mid-term assessment, however, a gradual improvement and increase in their performance, as well as grades, has been recorded. Therefore, it is evident from the figures that, if the learning management tools are optimally utilized in the course, it would lead to improved student engagement. The instructor added:

“though it is a bit challenging during the unusual times as online courses also make the learners isolated, I believe that little push from the instructor in terms of regular feedback would help them be more involved and engaged...”

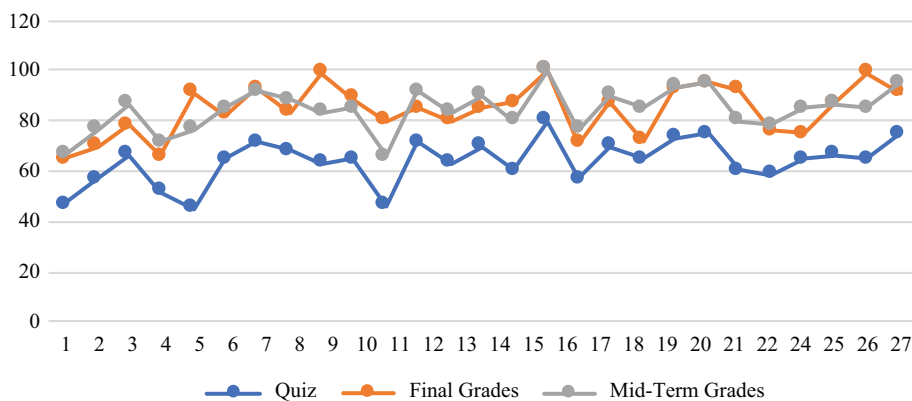


Fig. 3. Student academic achievement (after intervention)

An important observation that can be made is that, in an online environment, things that contribute to student engagement are the teaching methods, strategies, and interventions made by the instructors. Therefore, academicians and institutions should reconsider their teaching pedagogies to adapt to the online learning environment which contains special challenges as well diverse needs of students.

5 Discussion

Results and findings are one of the most important parts of any study so as a constrictive analysis afterward. The findings of the study indicate that student engagement in the online learning environment is important and is indicative of students' academic performance. The engagement levels were found to be satisfactory in all online activities. This engagement level led to higher performance among students taking the online course. In addition, when interventions were applied and students at risk were provided with constructive feedback, the performance improved further. The application of learning analytics tools has proven to be supportive of the same. The results of the paper confirm the value that learning analytics can be offered as an enabler to the instructors to make informed decisions as well as support students throughout their learning experiences. The findings are consistent with past studies [38], [39].

The survey findings suggest moderate to high levels of student engagement and high student satisfaction with real-time feedback provided by the instructor. The instructor provided weekly feedback to students on their performance and achievements. An interview with the instructor who adopted the model revealed that she noticed a "low level of attention and engagement" during the online course conducted in the Spring of 2020, and considered it a hindrance in the learning process. Therefore, for the following term (Fall 2021) she adopted LA at the course level and applied several technological tools along with LMS activities in the online classes. As suggested by past studies, the application of LA supports the instructor to run the online courses effectively.

The data from digital footprints can help Instructors and administrators make informed decisions for the improvement of student engagement and achieving educational effectiveness. With proper utilization of the LA Plugin and interventions, the instructor found an evident increase in online interactions as well as student outcomes. Further, the students at risk were also identified, provided feedback, and tracked for their performance.

Moreover, the study found that the instructors who apply LA in their courses do find it to be a useful tool, however, it poses some challenges in terms of technology, teaching strategy, and institutional support. It is more demanding than traditional F-2-F teaching. The instructors need to be committed as they play the role of a catalyst to stimulate better engagement among students in an online setting as well as continuously monitor their performances to provide regular feedback.

Any research can't be completed without a few challenges and roadblocks. During the research, several challenges were reported, a few were related to technical difficulties like weak connection and low level of technical support by the institution. Other challenges can be categorized as proficiency and training-related challenges. Upskilling of faculty members' technical know-how was an essential and critical element in making the online courses successful. Training provided to the instructors would help them cope with the ongoing challenges in academic functioning. Moreover, the unavailability of devices for some students also resulted in a digital divide. During the

pandemic and lockdowns, most of the members of one family used individual laptops for personal and professional tasks which created a high demand influx and limited socio-economical resources leading to difficult circumstances for many.

In the next section, an integrated learning analytics framework is proposed for educators that would support students in their learning outcome achievements.

6 The proposed integrated framework

This section addresses the last research objective; the development and proposal of an integrated framework. With digitization, the number of data footprints and digital traces is growing multifold [40]. These Digital traces and footprints can be derived from various sources like webcam feed, audio files, and log files from Learning Management System (LMS). The LA tools discussed in this study can capture the learning behaviors which cannot be recorded completely in a traditional face-to-face classroom [41].

Based on the gaps identified in the literature and findings from the survey and interview, an integrated framework has been developed. The framework (Figure 4) is holistic in approach and considers several key inputs for the online learning environment. For the first box “Design of LA Policy”, it is important that learning analytic strategy or policy is designed at the institutional or course level with clear, specific, and measurable objectives which are based on proper identification of the requirements. Past studies have identified several challenges and barriers to learning analytics regarding student data privacy, lack of technical support, and non-involvement of stakeholders [42] [43]. Amongst all these, the involvement of stakeholders is critical, and therefore, the proposed framework advocates the importance of stakeholder input in the first stage of the development of LA policy. Recent studies have identified the significance of having skilled and committed staff for the successful implementation of technology in online classes [44].

Further, the next box is for “Implementation of LA”. Data collection is integrated as the basic element in the next stage of the framework. At this stage, the tools and techniques to be used for the process must be procured and installed wisely for proper visualization of the data. One of the basic approaches used for LA applying LMS data is the plug-in of analytics (for example, MEAP+, LEMO2).

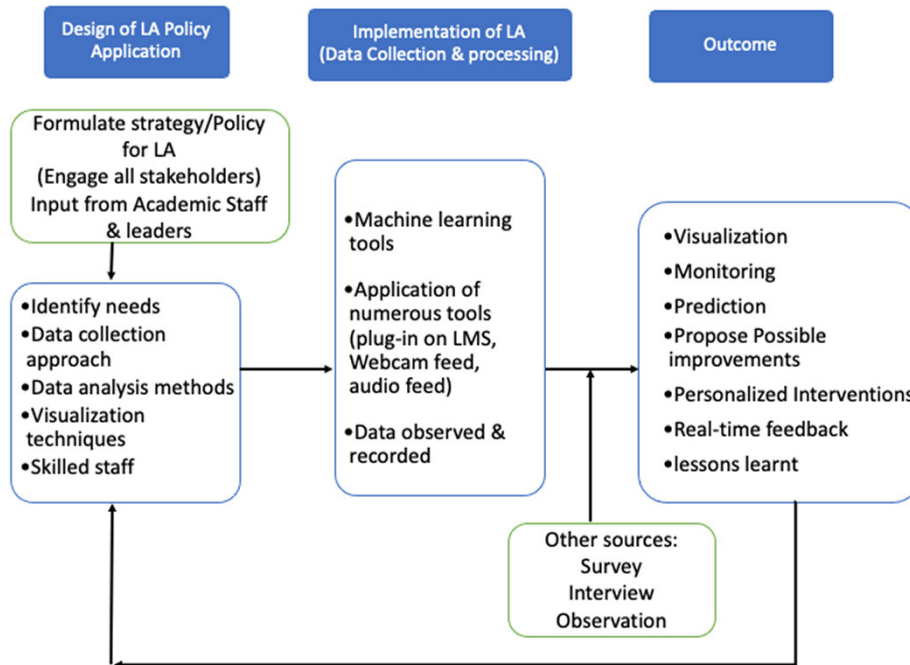


Fig. 4. Proposed integrated framework

The review of studies published in top journals of online education as well as other general studies shows that most of the studies focused on the application of LA for predictive analysis [45] which is solely based on the data gathered from various machine learning tools. Moreover, they ignored the significance of data collected from other means like observation, interviews, feedback, etc. Therefore, another important element in the framework is the data derived from these sources for triangulation purposes. This would help in providing both quantitative as well as qualitative inputs to the decision-maker or the instructor. At the stage of actual implementation, the data will be collected, stored, and analyzed using the tools and applications defined in the first stage of the LA policy. Last and most importantly, data must be provided to the stakeholders (academic advisors, program directors, instructors, etc.) to make interventions, monitor performance, predict outcomes, and make an informed decision. This also includes continuous and real-time feedback to the learners which would help them to either receive early warnings or a message to motivate them to continue and enhance their efforts. Thus, the proposed framework is inclusive enough for all domains and stakeholders to ensure that the objectives are met successfully.

7 Conclusion, implications, and limitations

The current study expands the literature by addition of new perspectives on student engagement in an online environment and the application of learning analytics. The

findings are aligned with the existing body of literature to ascertain that student engagement is the key to their participation and performance in online courses. In addition, the study confirms that LMS and learning analytics can be powerful tools to support predictions on student performances [46].

For the first research objective, the findings conclude that student engagement is satisfactory in the online course. It offers evidence and data-based recommendations to educators. For the second research objective, the study found a connection between online student engagement and student academic performance. The study concludes that student engagement in the online learning environment can be enhanced with the application of learning analytics tools and timely interventions by the instructors can lead to better academic performance among students.

The study provides adequate implication strategies for academicians to optimize LA with the help of LMS. In addition to developing a culture of data-driven education, devising a clear institutional policy is critical for the effective implementation of LA. Learning Analytics can play a pivotal role and revolutionize the learning experience in an online environment. Educators, practitioners, and administrators can learn the application of learning analytics and devise ways to foster and improve learner engagement in digital or online environments.

One of the limitations and research gaps of the current study can be seen in its limited scope in restricting it to the students of Riyadh city. Therefore, further studies are suggested to cater to a broader spectrum. Another limitation of this study was that the data for digital footprints could be captured only in LMS logs. For future research, it is recommended to use multiple sources of data that gauge not only the posts and texts on LMS but also the body language and eye movement through web feeds. This is included in the proposed framework which will be tested fully in the future study. It is hoped that the proposed framework will serve the community of academicians and practitioners, as a base for further research, and contribute to the field of learning analytics in the online environment.

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