

Promoting and Assessing Collaborative Learning using Learning Analytics in Higher Education– Overview of Drivers and Wheels

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Abstract

Learning analytics leverages the use of technology to gather and analyse data about student performance, engagement, and learning behaviours, which can help educators make informed decisions about how to improve learning outcomes. In higher education, learning analytics can provide insights into student engagement, performance, and learning pathways. Collaborative learning in higher education involves a group of students working together towards a common goal or task. Collaborative learning encourages students to work together to solve problems, analyse information, and make decisions, especially in self-directed learning environment. Through discussion and debate, students develop critical thinking skills and learn to approach problems from different perspectives to enhance problem-solving skills. Collaborative learning provides opportunities for students to work with others from diverse backgrounds, helping them develop interpersonal skills such as communication, teamwork, and leadership. While collaborative learning helps students to foster critical thinking and develop interpersonal skills, students' activities and engagement in collaborative learning are not properly assessed and measured. Student performance indicators are highly dependent on the learning activities and resources used in the learning management system based on individual basis. The ability and potential of learning analytics to track students' behaviour and performance in team, and to monitor the effectiveness of their sharing and communication is not fully utilised in higher education. This paper addresses this issue and aims to provide an overview of collaborative learning analytics. The overview elaborates essential elements in collaborative learning and defines features in analytics to support collaborative learning. The overview is expected to guide to educators and developers in promoting and assessing students' performance based on collaborative works.

Keywords: learning analytics, collaborative learning, higher education

INTRODUCTION

Learning analytics refers to the process of collecting, analysing, and reporting data about learners and their contexts to optimize the learning and teaching experience. Learning analytics leverages the use of technology to gather and analyse data about student performance, engagement, and learning behaviours, which can help educators make informed decisions about how to improve learning outcomes [1].

Learning analytics are highly relevant in the context of higher education, especially in. Education 4.0. Education 4.0 is characterized by the integration of advanced technology, such as artificial intelligence, machine learning, and big data, into the learning process [2]. In higher education, learning analytics can provide insights into student engagement, performance, and learning pathways. Learning analytics can help educators identify areas where students are struggling and provide targeted interventions to help them succeed [3]. Additionally, learning analytics can help institutions monitor student progress and identify

trends and patterns in student behaviour, which can inform pedagogical strategies and support continuous improvement.

Self-directed learning is becoming increasingly important in the context of Education 4.0. Self-directed learning plays important role in the context of Education 4.0 in higher education to promote lifelong learning. By encouraging learners to take ownership of their learning, self-directed learning trains learners to develop their skills beyond the classroom [4], [5]. Lifelong learning is essential in the current age of rapid technological advancements and changing job markets, where individuals must continuously update their skills to remain competitive [6].

Collaborative learning in higher education involves a group of students working together towards a common goal or task. Collaborative learning encourages students to work together to solve problems, analyse information, and make decisions [7]. Through discussion and debate, students develop critical thinking skills and learn to approach problems from different perspectives to enhance problem-solving skills. Collaborative learning provides opportunities for students to work with others from diverse backgrounds, helping them develop interpersonal skills such as communication, teamwork, and leadership.

While collaborative learning helps students to foster critical thinking and develop interpersonal skills, students' activities and engagement in collaborative learning are not properly assessed and measured. Student performance indicators are highly dependent on the learning activities and resources such as used in the learning management system [8]. With learning analytics, instructors not only can track student behavior and performance, but also monitor the effectiveness of their course content, and enhance their teaching techniques to better suit the needs of their students [9], [10]. However, learning analytics related to collaborative learning is still limited.

Teachers and practitioners find the challenges to integrate learning analytics into computer-supported collaborative learning design [11]. With the advent of learning analytics, the understanding of learning performance has shifted from analyzing performance indicators of individual actions to understanding social activity through interaction and collaboration [12]. By integrating learning analytics in collaborative applications it is hoped to help track and monitor the performance and engagement in collaborative learning as well as transform large educational databases into useful and meaningful information [13].

This paper addresses this issue to understand factors in collaborative and self-directed learning together with important features in learning analytics especially in the context of higher education. The paper aims to propose collaborative learning analytics framework to guide researchers and developers in the design of intended learning analytics.

COLLABORATIVE LEARNING IN HIGHER EDUCATION INSTITUTIONS

In higher education learning context, there are a few critical learning difficulties among students including time management, study skills, motivation and engagement. Time management appears to be among them because higher education demands a lot of time and effort from students, and managing time effectively is crucial [14]. Students who struggle with time management may find it difficult to balance coursework, extracurricular activities, and personal responsibilities.

Study skills in higher education context requires students to have strong ability to manage the learning process, including effective note-taking, critical thinking, and research skills [15]. Students who struggle with these skills may find it challenging to keep up with the workload and perform well on exams. Motivation and engagement are crucial for success in higher education. Students who lack motivation or are not engaged in their coursework may struggle to stay focused and perform well. Strong writing skills are essential for success in higher education as many of course assignments and projects require student to produce research papers and reports [16]. Students who struggle with writing may have difficulty expressing themselves clearly and effectively in written assignments.

These learning challenges and difficulties are not mutually exclusive and may overlap with one another. Providing comprehensive support to students is crucial for their success in the higher education context. The importance of collaborative learning in higher education context is related to the needs to provide support to students by promoting and encouraging students to participate in the collaboration.

Collaborative learning is an important aspect of education 4.0 in the higher education context. Optimum learning environment in higher education involves activities to foster critical thinking and problem-solving skills [17]. Collaborative learning encourages students to work together to solve problems,

analyse information, and make decisions. Through discussion and debate, students develop critical thinking skills and learn to approach problems from different perspectives.

Development of interpersonal skills need to be given attention in the context of higher education. Collaborative learning provides opportunities for students to work with others from diverse backgrounds, helping them develop interpersonal skills such as communication, teamwork, and leadership [9]. These activities encourage active learning through active participation, engagement, and involvement in the learning process. It helps students take ownership of their learning, leading to deeper understanding and retention of information.

Interaction among members in the learning group enhances creativity and innovation. Collaborative learning allows students to bounce ideas off each other and think outside the box, fostering creativity and innovation [18]. Collaboration is an essential skill in the workforce. Collaborative learning in higher education helps prepare students for the demands of the modern workplace by teaching them how to work in teams and communicate effectively with others [19].

Communication and coordination in collaborative learning could be enhanced using social media. The communication and coordination are based on interactivity with peers, teachers and online knowledge sharing behaviour, as presented in Fig. 1 [20]. Developing a collaborative learning framework enhanced by social media involves a multifaceted approach that leverages technology to foster interaction, knowledge sharing, and participation among students and instructors. This framework can significantly boost student engagement and academic performance by facilitating dynamic and interactive learning environments.

Effective interaction with instructors is a basis of collaborative learning [21]. Social media platforms can bridge the communication gap between students and educators, making instructors more accessible. These platforms allow instructors to provide timely feedback, share resources, and create discussion threads for various topics. This ongoing interaction helps students clarify doubts, gain deeper insights into the subject matter, and receive personalized guidance. The use of social media can also enable instructors to monitor student progress and participation more effectively, offering interventions when necessary to keep students on track.

Peer interaction is another critical component of collaborative learning. Social media platforms facilitate peer-to-peer communication and collaboration, enabling students to engage in discussions, form study groups, and work on group projects seamlessly [22]. These interactions promote a sense of community and belonging, which can enhance motivation and engagement. By discussing course materials and exchanging ideas, students can learn from each other's perspectives, thereby enriching their understanding of the subject. Furthermore, peer feedback and support can encourage a more collaborative and less competitive learning environment.

Online knowledge sharing behavior is a fundamental element in collaborative learning. Sharing behavior not only enriches the collective knowledge pool but also reinforces students' understanding as they articulate their thoughts and findings [23]. Encouraging students to share articles, videos, and other educational content can lead to more diverse learning materials and perspectives. Additionally, this practice cultivates a habit of continuous learning and information exchange, which is beneficial for students' academic growth and professional development.

Active participation is essential for the success of collaborative learning and online learning tools can significantly enhance student participation by providing a less formal and more engaging platform for interaction [24]. High levels of participation ensure that students are consistently engaged with the course content, which can lead to better retention and understanding.

The ultimate goal of enhancing communication and coordination through collaborative learning is to improve academic performance. Students who are more engaged and active in their learning process tend to perform better academically [21]. The increased interaction with instructors and peers, coupled with a robust culture of knowledge sharing, creates a more supportive and enriching learning environment, and eventually leads to better academic's achievement.

The framework was tested using a sample of 360 undergraduate students of a public university in Eastern India [20]. The confirmatory factor analysis (CFA) was conducted to ensure whether the observed variables measure the constructs as hypothesized by the theoretical model. The results indicated that interactivity with instructors, interactivity with peers, and sharing behaviour significantly influence students' engagement, which in turn has a notable impact on their academic performance.

The findings acknowledged that most university students today use social media to communicate with colleagues and teachers, and conveniently share resources. The increased student engagement in collaborative learning through online learning and social media leads to improved academic performance and helps students become more resourceful and energetic, connected with instructors worldwide. Consequently, there is a growing need for collaborative learning analytics to monitor and enhance these interactions effectively.

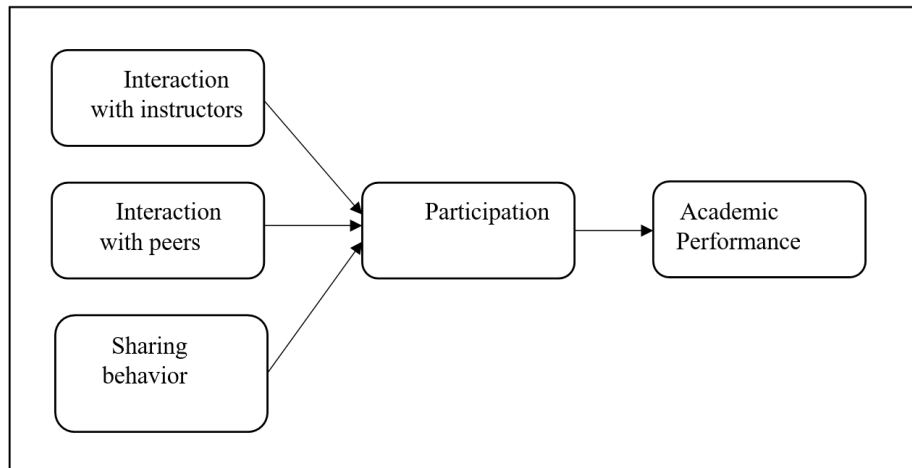


Figure 1. Collaborative learning framework [20]

COLLABORATIVE LEARNING ANALYTICS COMPONENTS

Learning analytics appears as an emerging discipline with the potential to transform education but brings as well as the challenges that need to be addressed. Learning analytics and the imperative for theory-driven research are among heating debates among researchers to gain balanced theoretical and practical application. Learning analytics needs to develop more theoretical underpinnings in order to be truly effective [5], [25], [26].

The potential of learning analytics to transform education includes the necessary to develop new analytical tools and techniques to fully exploit its potential in collaborative work [25], [27]. Learning analytics should be extended beyond individual learners to include social networks and collaborative learning environments [28]. Learning analytics can be a powerful tool for collaborative learning in higher education context. The development of learning analytics may consider some important elements.

Data plays important role in the system therefore data collection need to be given particular attention. Collecting data on learners' activities and behaviours is essential for understanding how they are engaging with in the collaboration and what they contribute so that the collaboration be successful [29]. This includes tracking usage of online resources, participation in online discussions, and completion of tasks. The foundation of a learning analytics platform is robust data collection and integration mechanisms. This involves gathering data from various sources such as Learning Management Systems (LMS), online discussion forums, group project tools, and other digital platforms used in collaborative learning.

Next, data analysis is another concern in learning analytics. Once data is collected, it needs to be analysed to identify patterns and trends that can inform instructional decisions. The selection of statistical techniques aims to identify patterns in various aspects of learning behaviour and performance [16]. Feedback and recommendations are also important features in learning analytics. Using the insights gained from data analysis, learning analytics can provide personalized feedback and recommendations to help learners identify areas where they need to improve participation in collaborative learning and suggest strategies for achieving their learning goals [30].

Visualization and dash boarding are another essential element in the system. Learning analytics data can be presented in clear and user-friendly formats to help learners monitor their progress, identify trends, and adjust their participation strategies as needed [31], [32]. This includes creating interactive dashboards and visualizations that provide real-time feedback on performance and progress towards goals. Selection of techniques using data mining, machine learning, and social network analysis techniques help

to analyse collaborative learning activities and improve the effectiveness of collaborative learning [33].

A collaborative learning analytics dashboard that combines data from multiple sources, such as learning management systems, social media, and sensor data may provide a comprehensive view of collaborative learning activities [19]. The dashboard includes visualizations that help instructors and students monitor and reflect on their collaborative learning practices.

Issues related to privacy and security need to be addressed in the design and development of such system. Learning analytics requires the collection and processing of sensitive data, so it is essential to prioritize privacy and security [29]. This involves developing policies and procedures to protect learners' data and ensure that it is used only for the intended purposes. By incorporating these elements into their learning analytics approach, institutions can empower learners to take control of their own collaborative learning and achieve their goals more effectively.

From student viewpoint, the collection and analysis of large amounts of data about their collaboration in learning can raise privacy concerns. Students may be uncomfortable with the idea of their personal data being collected and used without their explicit consent, especially if they don't fully understand how the data will be used [30]. Bias and discrimination may arise as a result of lack of strategy to address diversified students background and needs [34]. Learning analytics algorithms can perpetuate bias and discrimination, especially if they are not designed and implemented carefully [16]. For example, if an algorithm is based on historical data that reflects bias or discrimination, it may continue to reinforce those biases and discrimination in its recommendations and predictions.

A critical component of a learning analytics platform is the capability to provide timely and actionable feedback [35]. Based on the insights derived from data analysis, the platform should be able to generate personalized feedback for students, highlighting their strengths and areas for improvement in collaborative activities [19]. Additionally, the platform can suggest interventions, such as recommending additional resources, assigning peer mentors, or alerting instructors to provide extra support where needed. These interventions help in addressing issues proactively and enhancing the collaborative learning experience.

Limited usefulness could be related to the access of this system. While learning analytics can provide valuable insights into collaborative learning, it may not be useful in all contexts. For example, some courses or programs may not lend themselves to analysis using learning analytics, or the data collected may not be sufficiently informative [1].

Learning analytics may also need to overcome technical challenges. Implementing a learning analytics system can be technically challenging and require significant resources, including skilled staff, hardware, and software [36]. This can be a barrier for some institutions, especially those with limited resources. Overreliance on data is related to giving unnecessary expectation to the generated data without relying to real situation. There is a risk that learning analytics can lead to an overreliance on data at the expense of other factors that can influence student learning and participation in the collaboration, such as student engagement, motivation, and interest [37]. It's important to keep in mind that data is just one piece of the puzzle when it comes to improving educational outcomes.

Figure 2 summarises the critical components in collaborative learning analytics. The development of a learning analytics platform for collaborative learning in higher education involves integrating data collection mechanisms, employing sophisticated data processing techniques, utilizing effective visualization tools, providing personalized feedback and interventions, and adhering to privacy and ethical standards. These components work synergistically to enhance the understanding and improvement of collaborative learning practices, ultimately leading to better educational outcomes.

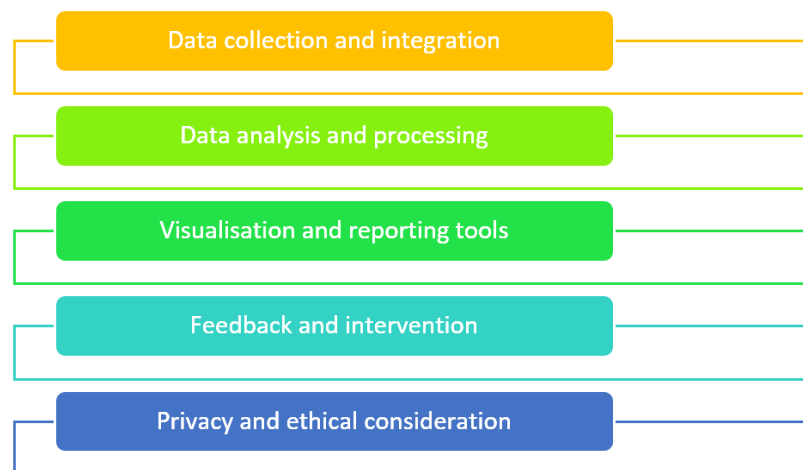


Figure 2. Collaborative learning analytics components

COLLABORATIVE LEARNING ANALYTICS TO HELP STUDENTS WITH LEARNING DIFFICULTIES

Learning analytics can be a valuable tool to support students with learning difficulties in higher education including in collaborative work. Collaborative learning analytics may help students and instructors in related to learning problems. Learning analytics may function in early identification of learning difficulties [29]. Learning analytics can help identify students who may be struggling early on in their studies. By analysing data on students' engagement, participation, and performance, learning analytics can flag potential learning difficulties before they become too severe [16].

Personalized learning is another potential to be applied in the system. Learning analytics can be used to create personalized learning experiences that cater to individual student needs. For example, by analysing data on how students are performing in specific areas, instructors can tailor their teaching to provide additional support or challenge to students as needed [5], [38].

Feedback and support are another important function in learning analytics. Learning analytics can provide real-time feedback to students, so they may identify areas where they need to focus their efforts. This can help students stay motivated and engaged in collaborative learning [37]. The system could provide learning projection using predictive modelling. Learning analytics can use predictive modelling to forecast students' performance and identify students who may be at risk of dropping out or failing a course. By intervening early and providing targeted support, instructors can help these students stay on track and achieve their academic goals [37].

Accessibility and structure of learning resources also become easier using this system. Learning analytics can help ensure that course materials and assessments are accessible and clear to all students, including those with learning difficulties. By analysing data on how students are engaging in the collaboration, instructors can identify areas where additional accommodations may be necessary [25].

Collaborative learning analytics can be a powerful tool to support and enhance teaching and learning in higher education. However, it cannot replace human instructors in the education 4.0 context. While learning analytics can provide valuable insights into student learning and help to optimize learning environments, it cannot replace the important role of human instructors in higher education. Instructors bring a wealth of experience, knowledge, and expertise that cannot be replicated by technology alone [39]. They provide guidance, feedback, and support to learners, help to foster critical thinking and problem-solving skills, and facilitate the development of important social and emotional skills [40].

Furthermore, human instructors are essential in creating a supportive and engaging learning environment [41]. They can adapt their teaching approaches and provide personalized support to meet the needs of individual learners. This is especially important in higher education, where students come from diverse backgrounds and have different learning styles and needs.

DISCUSSION AND CONCLUSIONS

Learning analytics are highly relevant in the context of Education 4.0, especially in higher education. Education 4.0 is characterized by the integration of advanced technology, such as artificial intelligence, machine learning, and big data, into the learning process. Learning analytics is the process of collecting, analysing, and reporting data about learners and their contexts to optimize the learning and teaching experience. Collaborative learning encourages students to work together to solve problems, analyse information, and make decisions. Through discussion and debate, students develop critical thinking skills and learn to approach problems from different perspectives.

Collaborative learning analytics can play a crucial role in supporting Education 4.0 in higher education, by enabling educators to measure and quantify students' involvement in collaborative work. Instructors make data-driven decisions that assess the learning experience of students in the collaboration to identify patterns, trends, and insights that can inform instructional design and support personalized learning experiences for students. Collaborative learning analytics can help students with learning difficulties in higher education by providing personalized support, early identification of difficulties, and real-time feedback and support. By using data to inform teaching and learning, instructors can help all students reach their full potential.

This article provides an overview of the drivers and developments in the field of collaborative learning analytics, as well as the challenges that need to be addressed. The article summarises progress and development in the field of collaborative learning analytics in higher education context and highlight its potential to transform education. The article also discusses the challenges that need to be addressed in order to fully realize this potential. These discussions on collaborative learning analytics highlight the growing interest in using data analytics to support collaborative learning in higher education and the potential of collaborative learning analytics to improve student success and learning outcomes.

While collaborative learning analytics can be a powerful tool to support teaching and learning in higher education, it cannot replace human instructors. Instructors play a critical role in creating a supportive and engaging learning environment and providing personalized guidance and support to learners. Self-directed learning is among important element in the context of Education 4.0 in higher education because it promotes lifelong learning, develops critical thinking skills, fosters creativity and innovation, enhances motivation and engagement, and prepares learners for the future of work.

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