

Trends in the use of flipped classroom model and its effectiveness in higher learning education: A systematic review

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ABSTRACT

A flipped classroom is an e-learning model that blends traditional face-to-face teaching and online teaching. It is gaining popularity in nowadays education systems. This review aimed to evaluate the research trends in the usage of flipped classrooms in higher learning education. During the review, sources were retrieved from various databases such as Google Scholar, Scopus, and ERIC to name a few. Using systematic search and selection methods to answer the proposed research questions regarding the types of methodological approaches that have been regularly used in the flipped classroom research; subjects of flipped classroom teaching practices have been widely researched; kind of technological platforms have been used in flipped classroom research; the outcomes of flipped learning research and the challenges encountered in flipped classroom implementation. The analysis showed that the quantitative methods are the most used while education is the subject most reported in flipped classroom research. Learning management systems are the most technological platforms that have been used in flipped classroom research. Academic achievement is the major learning outcome reported in the analysed flipped classroom research. The reluctance of instructors and students to adapt to new roles is among the challenges reported in the analysed reports. Overall flipped classroom model has a positive effect on students' learning outcomes. Therefore it is encouraged to use the flipped classroom model taking into consideration the challenges reported to make it more effective.

Keywords: Flipped classroom, higher learning education, academic achievement, motivation.

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INTRODUCTION

To effectively engage students in the teaching-learning process and encourage them to study outside of class, researchers and teachers have looked into various methodologies and teaching techniques. One of these possibilities is the flipped classroom, a new educational trend that is predicted to become widely adopted in tertiary education during the next several years (Demiralay, 2014). This blended learning model, which is a new pedagogical strategy, inverts conventional face-to-face instruction. This methodology efficiently uses technology and offers a unique teaching-learning experience. In this strategy, videos are used to teach students theoretical concepts and various exercises outside of class, and implementations are carried out during in-class study time (Bergmann and Sams, 2012;

Strayer, 2012). That is, in the flipped classroom, students are instructed at home and exposed to the assignment model at school (Demiralay, 2014).

The flipped classroom, a cutting-edge teaching strategy, differs from the conventional face-to-face teaching approach in that students complete their homework whenever and wherever they wish prior to attending class. As a result, teachers frequently prepare the topics of their classes using digital resources and give their students access to these resources before lessons. In this approach, students are guided by their teachers, to the pertinent instructional materials and informed of those materials prior to classes. Through the use of technology, students notice and present any problems that are unclear, difficult, or cannot be fully

absorbed by their teachers and classmates. By this means, the flipped classroom aims to address students' cognitive differences.

When students come to the classroom, they will have more time to allocate to the activities and applications supporting the issue and will participate in the teaching-learning process more effectively and efficiently (Abeysekera and Dawson, 2015; Baker, 2000; Chen et al., 2014). In this way, students are provided with new opportunities for the subjects that are not learned in a classroom environment through flipped classroom technology (Kim et al., 2014). Bergmann and Sams (2012), who are considered the pioneers of the flipped classroom, claim that this approach does not only entail video courses; rather, the important and engaging activities carried out in classes are its essential component.

The flipped classroom model has emerged as a significant pedagogical innovation, challenging traditional teaching methods and offering a dynamic approach to enhance student engagement and learning outcomes. A study by Bergmann and Sams (2012) introduced the concept of the flipped classroom, emphasizing the reversal of the traditional instructional process where students first encounter new content at home through multimedia resources and then engage in collaborative and interactive activities in the classroom. This inversion allows students to pace their learning, revisit challenging concepts, and fosters a more personalized learning experience.

One key importance of the flipped classroom lies in its potential to improve student engagement. Strayer (2017) suggests that pre-class assignments, often in the form of videos or online modules, can capture students' attention and cater to diverse learning styles. As students come to class with a foundational understanding of the material, in-class time can be dedicated to higher-order thinking skills, collaborative projects, and problem-solving activities. The increased interactivity can lead to a more participatory and engaging learning environment, which is essential for fostering deep understanding and retention of the subject matter.

Moreover, the flipped classroom model contributes to the development of self-directed learning skills. Students, by taking responsibility for their pre-class learning, develop the ability to manage their time effectively and engage in self-directed study. A meta-analysis by Hew and Lo (2018) found that students in flipped classrooms demonstrated increased autonomy and self-regulation compared to their counterparts in traditional classrooms. These skills are crucial for lifelong learning and are highly valued in today's rapidly changing knowledge landscape.

Furthermore, the flipped classroom has shown promise in improving learning outcomes. A recent study by Shao and Liu (2021) investigated the impact of the flipped classroom model on student achievement and found positive effects on exam scores and overall academic performance. The personalized and active learning experiences facilitated by the flipped model contribute to a deeper understanding of the subject matter, translating into improved outcomes across

various disciplines.

In the contemporary landscape of higher education, numerous challenges pose hurdles to effective learning. Overcrowded classrooms, limited student engagement, and the struggle to accommodate diverse learning styles are just a few of the prevalent issues. The Flipped Classroom approach offers a promising solution to these challenges. By utilizing technology to deliver content outside of class time, instructors can make more efficient use of precious face-to-face sessions. This can alleviate issues related to overcrowded classrooms, allowing for more personalized attention during in-person interactions (Bishop and Verleger, 2013). Moreover, the Flipped Classroom model promotes active learning, addressing the concern of disengaged students. The interactive in-class activities foster a collaborative and participatory learning environment, enhancing student motivation and involvement in the learning process (Mazur, 2009).

The diversity of learning styles within a classroom often poses a significant challenge to educators. The Flipped Classroom model, by enabling students to consume content at their own pace outside of class, accommodates various learning preferences. Students who may require additional time to grasp complex concepts can revisit instructional materials as needed, while those who grasp concepts quickly can proceed to more advanced topics (Tucker, 2012). This flexibility in learning can contribute to a more inclusive educational environment that caters to the individual needs of a diverse student body. Moreover, research suggests that the Flipped Classroom approach is particularly beneficial for students with different learning styles, providing them with an opportunity to engage with the material in ways that suit their preferences (Tucker, 2012).

The challenges faced by higher education today, such as overcrowded classrooms, low student engagement, and accommodating diverse learning styles, necessitate innovative solutions. The Flipped Classroom approach, with its emphasis on active learning, flexibility, and personalized instruction, addresses these challenges head-on. As educators seek effective strategies to enhance the quality of education and meet the diverse needs of students, the Flipped Classroom model emerges as a promising pedagogical tool in higher learning institutions.

The employment of the flipped classroom approach is becoming more and more prevalent in modern societies. However, despite the increased popularity of its research, there is a lack of empirical evidence that summarizes the positive impacts and challenges of flipped classroom implementation from various works. Besides, a few studies have also been performed to critically analyze this issue systematically. Therefore, based on these rationales, this study aims to rigorously review and analyze a number of selected publications from a wider research topic in a pedagogical context.

Objective

This study aims to undertake a review of published

scientific literature on flipped classroom usage in higher learning instruction.

This involves locating, classifying and analyzing research conducted on the topic. This study concentrates on describing peer-reviewed journal articles on the topic, and answers the following questions:

1. What types of methodological approaches have been regularly used in flipped classroom research in terms of (a) learning theories, (b) Research approach, (c) Research designs, (d) Data collection tools?
2. What subjects of flipped classroom teaching practices have been widely researched in 2018 and 2022?
3. What kind of technological platforms have been used in flipped classroom research?
4. What are the outcomes of flipped learning research between 2018 and 2022 in terms of student learning?
5. What are the challenges encountered in flipped classroom implementation?

Conceptual framework of the study

In this research framework, the independent variable is the Flipped Classroom model, a pedagogical approach

that involves the inversion of traditional teaching methods, where instructional content is delivered outside of the classroom, and in-class time is dedicated to active learning and application of knowledge. The intervening variables include methodological approaches and technological platforms employed within the Flipped Classroom. Methodological approaches encompass the diverse strategies used in designing and implementing the flipped model, such as collaborative activities, problem-solving exercises, and interactive discussions. Technological platforms refer to the tools and resources utilized, such as Learning Management Systems (LMSs), multimedia presentations, and virtual labs. These intervening variables play a crucial role in shaping the overall effectiveness of the Flipped Classroom model. The dependent variable in this research context is the learning outcomes achieved by students across various subjects. Learning outcomes include but are not limited to academic performance, critical thinking skills, and subject mastery. Herein this study reported data on the trends in the effectiveness of the Flipped Classroom model on the learning outcomes as well as trends on the intervening variables such as methodologies and technological platforms reported in the analysed literature. Figure 1 shows the interrelationships between the variables that guided this literature review.

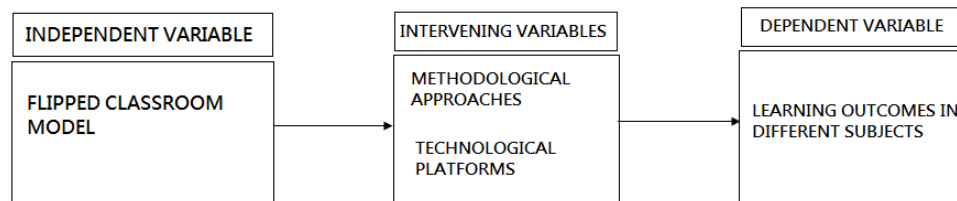


Figure 1. Conceptual framework of the study.

METHODOLOGY

Research design

In this study, an inductive content analysis was used to analyze 34 refereed journal articles on flipped classroom research published in 2018 and 2022. Content analysis is a research technique usually applied in social science and humanities (McMillan, 2012). Creswell (2013) Inductive content analysis, which is similar to other qualitative coding strategies, is used when the researcher needs to find themes within written texts, artifacts, videos, pictures, and recordings, it was added. There was no tested theory or theoretical framework because the study was inductive. This study included both quantitative and qualitative data analyses.

As Bozkurt et al. (2015) mentioned, content analysis is one of the research design methodologies that employs both qualitative and quantitative approaches to investigate empirical documentation to group comparable cases or data according to particular concepts and themes and then organize and interpret the data systematically. During the content analysis,

themes might emerge as an emergent model and preset codes can also be used (Zainuddin et al., 2019). It is in that perspective that specific research questions were formed from the aim of the research. This was followed by defining terms from which grouping data into categories was made. The unit of analysis was determined to be words that were analyzed in the form of percentage of similarity. Thereafter the articles on flipped classrooms were located from various databases.

Database search and source selection

Materials (articles) were chosen using the approach described by Álvarez-García et al. (2015), for systematic reviews. Using a consistent search approach and established criteria for article selection, peer-reviewed journal articles were found and assessed as shown in Table 1. In order to find publications, search engines like Google Scholar and scientific databases like ERIC, Google Scholar, BiomedCentral, and Scopus were employed. The classification and choice of key terms

formed the strategic foundation for the search. The search was conducted using keywords relating to blended classrooms, flipped classrooms, technology-mediated instruction, web-enhanced instruction, or

mixed-mode instruction in higher learning instruction. The search was carried out in English language. The WoS database was used to validate all journals. Figure 2 shows the PRISMA flowchart for source selection.

Table 1. Criteria for sources selection.

Scope	National and international
Research types	Empirical research on the use of flipped classrooms in university education
Journal	Peer reviewed
Period	Preferably 2018-2023
Targeted group	Undergraduate university students
Language	English

Table 2. Articles downloaded and analyzed in this study.

No	Journals	No. of articles	References
1	<i>Journal of the College of Physicians & Surgeons Pakistan</i>	1	Afzal and Masroor (2019)
2	<i>International Journal of Technology Enhanced Learning</i>	1	Alamri (2019)
3	<i>International Journal of Research in Education and Science,</i>	1	Albalawi (2018)
4	<i>Journal of Education and Health Promotion</i>	1	Angadi et al. (2019)
5	<i>Education Sciences</i>	1	Díaz et al. (2021)
6	<i>Pakistan Journal of Medical Sciences,</i>	1	Rehman and Fatima (2021)
7	<i>International Review of Research in Open and Distributed Learning,</i>	1	Cabı (2018)
8	<i>Journal of Chemical Education,</i>	1	Casselman et al. (2020)
9	<i>English Language Teaching</i>	1	Du (2020)
10	<i>Malaysian Online Journal of Educational Technology,</i>	1	Sirakaya and Ozdemir (2018)
12	<i>International Journal for the Scholarship of Teaching and Learning</i>	1	Gomez-lanier (2018)
13	<i>Turkish Journal of Computer and Mathematics Education</i>	1	Haqiyah et al. (2021)
14	<i>Sustainability</i>	2	Hinojo-lucena et al. (2018), Zhao and Liu, (2021)
15	<i>Procedia Computer Science</i>	1	Hoshang et al. (2021)
16	<i>International Journal of Educational Technology in Higher Education,</i>	1	Hussain et al. (2020)
17	<i>International Journal of Instruction,</i>	1	Jdaitawi (2019)
18	<i>The Electronic Journal of E-Learning,</i>	1	Jdaitawi (2020)
19	<i>Journal of Science Education and Technology,</i>	1	Jensen et al. (2018)
20	<i>International Journal of Management Education</i>	1	Lopes and Soares (2018)
21	<i>British Journal of Educational Technology</i>	1	Luo et al. (2018)
22	<i>Ethical Lingua</i>	1	Mandasari and Wahyudin (2021)
23	<i>Computers & Education</i>	1	Murillo-zamorano et al. (2019)
24	<i>Turkish Online Journal of Distance Education</i>	1	Talan and Gulsecen (2019)
25	<i>BMC Medical Education</i>	2	Røe et al. (2019), Zheng and Zhang, (2020)
26	<i>International Journal of Emerging Technologies in Learning</i>	1	Santikarn and Wichadee (2018)
27	<i>Journal of Computer Assisted Learning</i>	1	Shyr and Chen (2018)
28	<i>Higher Education</i>	1	Sointu et al. (2022)
29	<i>Interactive Learning Environments,</i>	1	Tang et al. (2020)
30	<i>International Journal of Interactive Mobile Technologies</i>	1	Umam and Mulyono (2019)
31	<i>TEM Journal,</i>	1	Wannapiroon and Petsangsri (2020)
32	<i>International Journal of Information and Education Technology</i>	1	Xiao-dong and Hong-hui (2020)

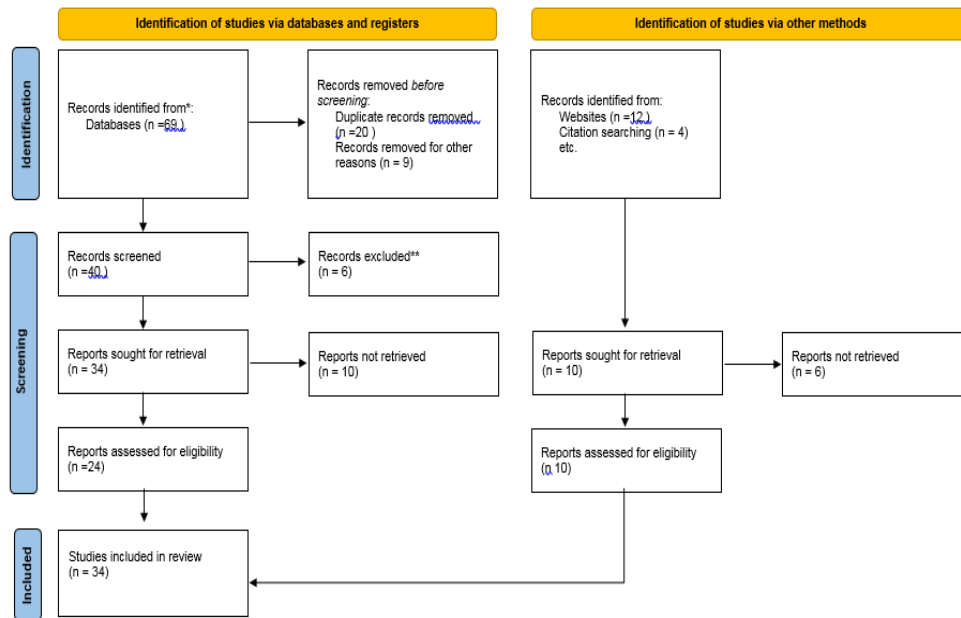


Figure 2. PRISMA flow chart followed while selecting sources analysed in this review.

Data collection procedure and analysis

The following is the procedure for gathering data in this study: First, develop the study's objectives and examine and analyze the trends and contents of flipped classroom research using a variety of criteria, including methodological techniques, disciplines of study, technological platforms, keywords, positive benefits, and challenges. Second, when reviewing the documents, the articles containing the aforementioned keywords were downloaded and individually reviewed. Third, data were gathered and descriptively examined using content analysis.

The analysis was done by categorizing data into categories according to key terms highlighted in the research questions. For instance the research question one the categories were namely: learning theories, Research approach, Research designs, as well as Data collection tools. For the second research question there was only one category which was learning subjects, while the third research question which concerned with technological platforms, the categories were Computer applications, Learning management systems, and Visual displays. In the fourth research question, there was one category which is the learning outcomes. The data to address the fifth research question were categorized into Technical challenges, Motivation and behavioral challenges as well as Content related challenges. In each category of data, the similarity of the data from analyzed articles was checked across all the articles. The frequency of the similarity in the form of percentage was estimated, by taking the number of articles the similar data was found times hundred and divided by the total number of articles analyzed. Fourth, the authors discussed, concluded, and proposed potential future research that may be conducted to contribute to the

flipped classroom literature gaps.

RESULTS AND DISCUSSION

This section presents and discusses the findings of the study based on the proposed research questions about the use of flipped classrooms in higher learning education.

Methodological approaches have been regularly used in flipped classroom research

Learning theories and models

Most educational research are based on certain educational theories to better understand the teaching and learning being investigated. It is in that perspective that in the analysed articles on flipped classroom usage; the learning theories were sought using content analysis. The finding shows that many articles analysed did not report any learning theory. Among others, constructivism is the major learning theory reported in few articles mentioned any learning theory. Bloom's taxonomy, grounded, ADDIE model was also reported. The findings from this analysis are presented in Figure 3.

Constructivism is being highlighted in numerous domains related to education as an alternative educational ideology and approach, with a socially urgent need for the revolutionary transformation of an educational environment suited for 21st-century society. Using educational technology as a constructivist tool could assist students in representing their ideas, communicating what they know, and exploring, manipulating, and processing information while actively

engaging with one another. Constructivism, as a teaching philosophy, uses research into the nature of learning to guide pedagogy. Educational technologies, from a constructivist perspective, are potential tools for implementing curriculum through specific pedagogical approaches. As a result, new technologies contribute to

the teacher's toolkit, providing various approaches to facilitate learning within an established technique. Although they present the teacher with many new opportunities, digital technologies should never be utilized as a means in and of themselves. Instead, they should be integrated into principled pedagogy (Taber, 2017).

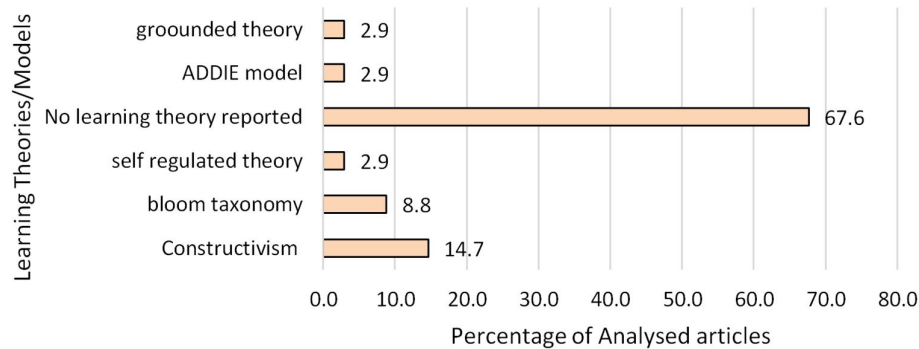


Figure 3. Learning theories and models used in Flipped Classroom research.

Using technology tools such as Web 2.0 applications promotes constructivist learning principles in the classrooms. Web 2.0 tools can be thought of as 'intellectual partners' in the process of collaborative learning to encourage higher-order and more analytical thinking. Learners can design and complete imaginative, higher-level projects using graphics, pictures, animation, and videos. Learners have a "complex laboratory in which to observe, question, practice, and validate knowledge" when the constructivist method and Web 2.0 are used in the classroom. Constructivist pedagogy encourages students and teachers to focus on thinking and understanding rather than memorization of specific content by supporting the use of technology (Dillon, 2004; Yasemin, 2016). Additionally, it offers opportunities for constructivist learning, independent learning, and group learning. The production of knowledge for pupils using the constructivist method is also accelerated by the use of technology (Asiksoy and Ozdamli, 2017). It was shown that the integration of constructivist had a positive contribution to students' success, attitudes and motivation and plays a part in their enjoying learning (Fridin, 2014).

The ADDIE model is an instructional systems design (ISD) framework that many instructional designers and training developers use to develop courses. It was created by the Centre for Educational Technology at Florida State University. The ADDIE model was developed by Dick and Cary in 1978 and Russell Watson revised it in 1981 and was considered essential in the development of educational and training programs (Muruganantham, 2020). ADDIE model proved itself as a very useful instructional model in the preparation of materials for traditional teaching and there is a strong intention to use this model for electronic and online teaching materials (Drljača et al., 2017).

Implementing the ADDIE model instructional design model in the context of a Flipped Classroom presents

profound implications for both educators and institutions in higher learning. The systematic approach of ADDIE allows teachers to meticulously analyze the needs of their students, design tailored instructional materials, develop engaging content for pre-class consumption, implement the Flipped Classroom model effectively, and evaluate its impact on student learning outcomes. This structured process not only empowers educators to create high-quality learning resources but also facilitates continuous improvement based on assessment and feedback. For institutions, the integration of ADDIE in a Flipped Classroom setting ensures consistency in instructional design, aligning with educational objectives. The model supports scalability and adaptability to diverse subject matters and student populations, enhancing the overall effectiveness of the Flipped Classroom approach (Molenda, 2003; Smith and Ragan, 2005). Consequently, the combination of ADDIE and the Flipped Classroom model offers a comprehensive framework that promotes thoughtful planning, reflective teaching practices, and the optimization of learning experiences for both teachers and institutions.

Bloom's taxonomy is perhaps the most prominent concept in education, particularly for teaching and learning. This taxonomy has divided learning into three behavioral domains, that is, cognitive, affective and psychomotor, with the main focus on the cognitive domain because of its possible application in primary, secondary and tertiary education. Each of the three categories is further organized into six levels from simple to complex. Since Bloom's Taxonomy is the benchmark for developing tests and assessments (Chandio et al., 2016). The study suggests the adoption of Bloom's digital taxonomy in teaching-learning processes, that is, curriculum, instructions and assessment for the millennials. The findings may motivate online and conventional higher education institutions to adopt digital pedagogy for instructional purposes as the students of

the digital age are already extensively involved with digital tools (Amin and Mirza, 2020). Churches (2009) has promoted “Bloom’s Digital Taxonomy” and outlined how the digital taxonomy offers tools and procedures for conceptual understanding as well, not just for the cognitive domain. The evaluation of this model in terms of Bloom’s taxonomy steps revealed that students watch videos prior to class to fulfill their learning requirements for knowledge and comprehension, and they participate in classroom activities to fulfill their requirements for application, analysis, synthesis, and evaluation

(Rutkowski and Moscinska, 2013).

Research approach

This analysis aims to answer research Question two “What type of methodological approaches has been regularly used to study the flipped classroom?” From the analysis according to Figure 4, it was that found the majority of studies used a quantitative approach and mixed methods, followed by qualitative.

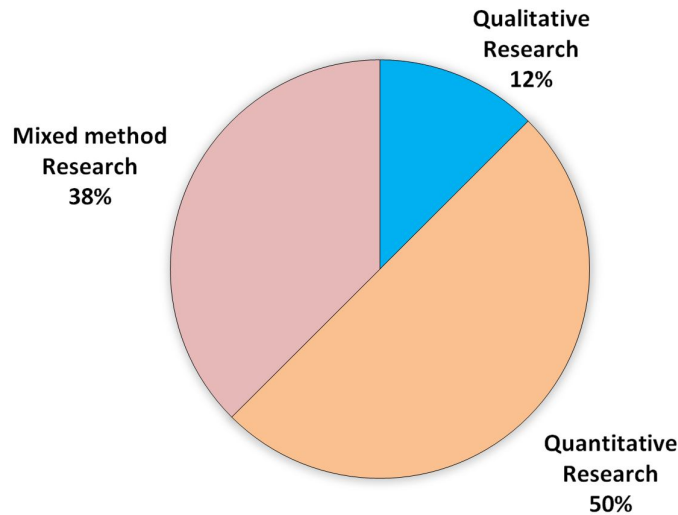


Figure 4. Research approaches used in Flipped Classroom research.

The quantitative research approach is the main approach used (up to 50% of the analyzed articles). Mixed method research was 38% whilst qualitative research was reported in 12% of the analyzed articles. Quantitative methods in education engage in the science and practice of educational measurement and evaluation, primarily through the development and application of statistical methods, informed by the study of teaching and learning statistics. Education research frequently employs quantitative methods. Quantitative education research provides numerical data that can prove or disprove a theory, and administrators can easily share the quantitative findings with other academics and districts. While the study may be based on relative sample size, educators and researchers can extrapolate the results from quantitative data to predict outcomes for larger student populations and groups. The essential is to evaluate quantitative analysis and provide the research process, sampling techniques, and the advantages and disadvantages of quantitative research in the article. A comprehensive presentation of quantitative research design and statistical methods in education and related fields is crucial. Researchers in education, counselling, rehabilitation, psychology, sociology, social work, and human development can also benefit from advanced quantitative research (Dimitrov, 2008). A concern for generalization

dominates quantitative research (Siripipatthanakul et al., 2023).

Mixed methods research is recognized as a third model of research in social and behavioral sciences. A mixed methods research study means the use of quantitative and qualitative methods as components of a research design or a research program (Creswell and Plano Clark, 2011). It is believed that the use of both quantitative and qualitative research findings in the same study maximizes the strength of each approach and can provide a better understanding of biology teaching and learning than either approach alone (Warfa, 2016). Furthermore, Creswell (2012) inspires the use of Mixed methods designs in experimental studies in which there is a strong need for a deep understanding of how the experimental intervention actually worked. Therefore it is not surprising that mixed methods were also employed in the analyzed articles.

Qualitative research is very important in educational research as it addresses the “how” and “why” research questions and enables a deeper understanding of experiences, phenomena and context. Qualitative research allows you to ask questions that cannot be easily put into numbers to understand human experience (Cleland, 2017). All qualitative studies begin with such problems. Qualitative research gives the researcher something to look for. They should not be considered

restrictive or limiting, however, since their purpose is to provide direction and to serve as a guide (Fraenkel et al., 2012). This explains why the qualitative research approach is also reported in a few articles analysed in this study.

Research designs and data collection tools

Findings in this study show that 44.1% of the analysed articles implemented experimental design, followed by survey design (four papers), case study (three papers), randomized clinical trial design (one paper), phenomenological study (one paper), exploratory study (one paper) and grounded theory design (one paper). The other studies did not explicitly mention the design approach used, instead stating multiple data collection

methods used, such as tests or assessments, questionnaires, interviews, focus group discussions, or observations. Furthermore, in terms of data collection methods, as depicted in Table V, most studies used questionnaire surveys (38 studies), followed by experimental tests or assessment (28 studies), interviews/focus groups (24 studies), observations (14 studies) and others (four studies), including learning management system (LMS) records/documents, documents analysis, videos, tasks, diaries, and expert Delphi.

The research designs employed in the reported articles are mostly experimental types, that is, quasi-experimental 29.4%; repeated measure quasi-experimental 5.9%, experimental 44.1% while cohort study and longitudinal study both had 2.9% (Figure 5).

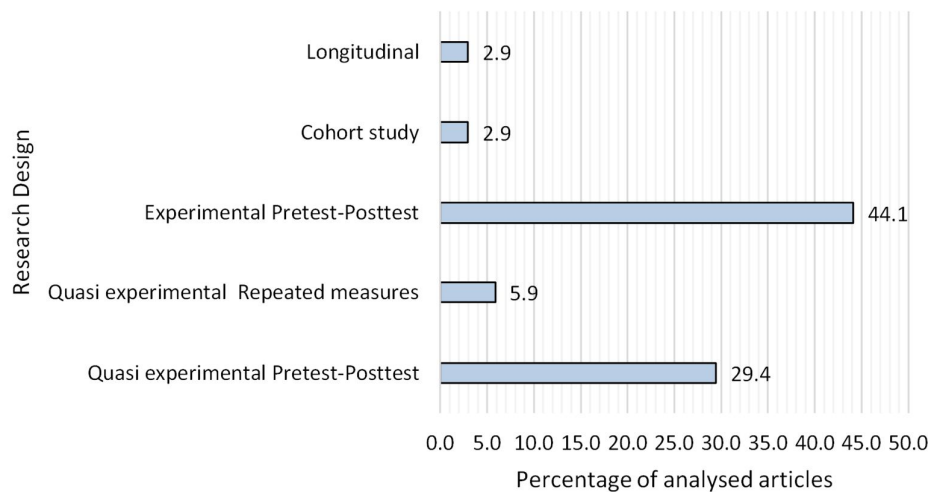


Figure 5. Research designs used in Flipped Classroom research.

Experimental designs play a pivotal role in educational research, providing a rigorous methodological framework to investigate the causal relationships between interventions and outcomes. By employing experimental designs, researchers can systematically control variables, randomize participants, and manipulate independent variables, allowing for a more accurate assessment of the impact of educational interventions. Recent studies emphasize the significance of experimental designs in assessing the effectiveness of various educational strategies. For instance, a study by D’Mello et al. (2020) utilized a randomized controlled trial to evaluate the impact of a technology-enhanced learning intervention on student engagement and achievement. Additionally, the work of Hattie (2012) underscores the importance of well-designed experiments in identifying the factors that most significantly contribute to student learning. The use of experimental designs ensures the reliability and validity of educational research findings, contributing to the evidence-based improvement of teaching and learning

practices.

Questionnaires are the most data collection tools used in flipped classroom research where they are reported in 61.8% of the analysed reports. On the other hand, tests, assessments and examinations were reported in 38.2% of the analysed flipped classroom research. Surveys and interviews were reported in 17.6% of the analysed reports, while observation and focus group interviews were respectively reported in 8.8% and 5.9% of the reports analysed. Lastly, students' journal and self-reflection report was reported in 2.9% of the analysed articles (Figure 6).

Questionnaires serve as valuable instruments in educational research, offering a structured and efficient means to gather data on a wide range of topics, from student perceptions to teaching methodologies. Recent studies emphasize the versatility and effectiveness of questionnaires in examining various aspects of the educational landscape. For instance, a study by Krosnick and Presser (2010) highlights the methodological advancements in questionnaire design, ensuring

the reliability and validity of survey data. Additionally, the work of Dörnyei and Taguchi (2009) underscores the utility of questionnaires in investigating motivational factors in language learning contexts. The use of well-

crafted questionnaires enables researchers to collect quantitative data on a large scale, providing insights into diverse educational phenomena and informing evidence-based decision-making in educational settings.

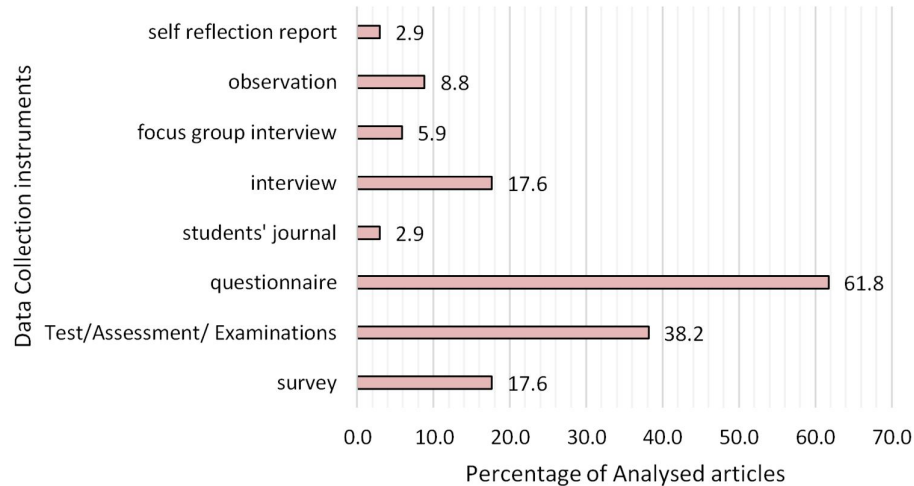


Figure 6. Data collection tools used in Flipped Classroom research.

Subjects of flipped classroom teaching practices have been widely researched in 2018 and 2023

The flipped learning subject areas of the 34 reviewed studies were examined. The data indicate a wide range of the subject area of each study: (1) education, (2) medicine, (3) engineering, (4) economics, (7) science and applied science, English language learning, and psychology to name a few. The results on subject areas examined in the analysed articles are reported in the figure, (8) arts and letters, and (9) uncategorized.

Most of the research in the reviewed studies was conducted in the fields of education (i.e., teacher education, educational sciences, English language teaching, mathematics education, science education, educational psychology, educational technology (20.6%) and medicine (17.6%) as well as science and applied science (17.6%). Flipped learning research studies have also been conducted in other fields such as mathematics which was reported in 8.8% of the articles, communication reported in 5.9%, and psychology and economics both reported in 2.9% of the analysed articles (Figure 7).

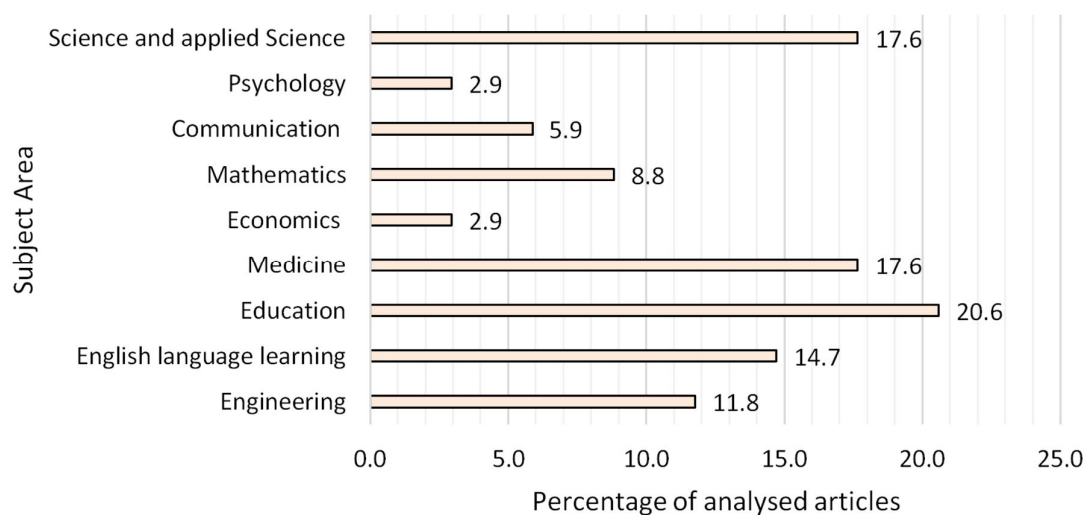


Figure 7. Subject areas reported in the analyzed articles about Flipped Classroom.

The implications of the mentioned text reveal a pattern in the distribution of research studies on flipped learning across various academic disciplines. The predominant focus on education, encompassing teacher education, educational sciences, and diverse subject-specific education areas like English language teaching, mathematics, and science education, underscores the significant interest and application of the flipped learning model in pedagogical contexts. The notable presence of research in medicine and science/applied science suggests an expanding application of flipped learning beyond traditional educational settings, extending into professional and scientific domains. The inclusion of mathematics, communication, psychology, and economics in the spectrum of flipped learning research demonstrates the versatility of this pedagogical approach, transcending disciplinary boundaries. These findings imply a growing recognition of the potential benefits of flipped learning across diverse fields, emphasizing its adaptability and relevance for fostering enhanced learning experiences beyond the realm of education, and into professional and scientific spheres.

This diversity in research focus underscores the need for interdisciplinary collaboration and exchange of best practices to further enrich the understanding and implementation of flipped learning across various domains.

Kinds of technological platforms used in flipped classroom research

This analysis attempts to answer the research question “What kind of technological platforms have been used in flipped classroom research?” From 34 analyzed papers, it was found that several studies used various learning platforms to record and share video lectures and content or as an online platform for peer interaction outside of the classroom. An examination of 34 publications utilized in this study to highlight trends and findings of research into the flipped learning paradigm, for instance, reveals how many studies used various technological tools to promote flipped learning in 2018–2023. The results are summarized in Figure 8.

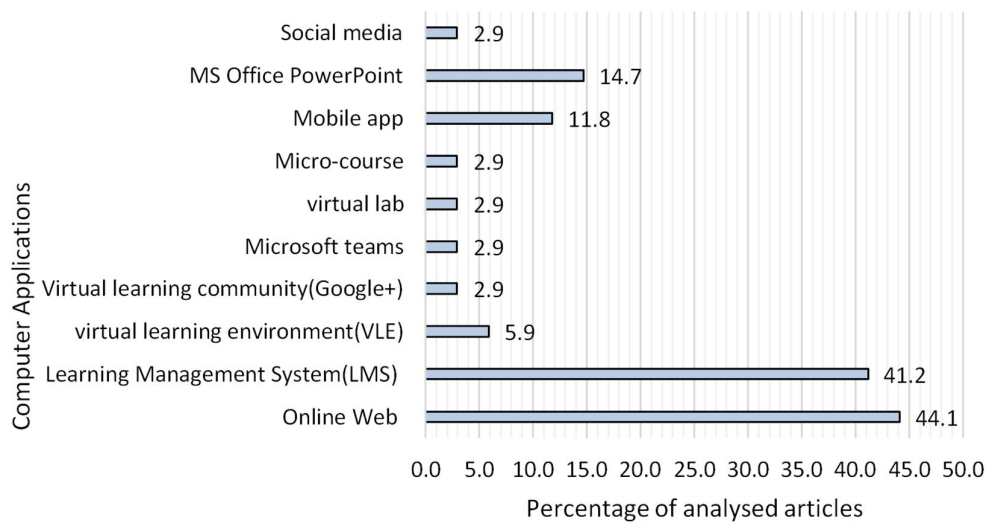


Figure 8. Computer applications reported in the analyzed articles about Flipped Classroom.

Computer applications

Learning management systems (LMSs) are one of the most used computational applications along with online webs which were respectively reported in 41.2 and 44.1% of the analyzed articles. Types of learning management systems (LMS) found in the analyzed articles are summarized in Figure 9. Other computer applications such as MS PowerPoint were reported in 14.7% of the analyzed reports. Computational tools such as virtual learning community (Google+), social media, Virtual lab, and Microsoft teams were reported in 2.9% of the analyzed articles. Mobile apps are also other technological platforms used in flipped classroom research which were reported in 11.8%.

The implications of the provided text highlight the

prevalent use and diversity of computational applications in the context of flipped classroom research. Learning Management Systems (LMSs) and online platforms constitute a substantial portion of the technological landscape, being reported in over 40% of the analyzed articles. This underscores the central role of digital platforms in facilitating the implementation of flipped classroom models. The mention of tools like MS PowerPoint, social media, Virtual lab, Microsoft Teams, and mobile apps reflects the multifaceted nature of technological tools leveraged for flipped classroom approaches. The diversity in the use of these tools suggests a dynamic and evolving technological ecosystem in education, indicating that educators and researchers are exploring various platforms to enhance the effectiveness of the

flipped classroom model. This technological diversity not only reflects the adaptability of educators but also

suggests an ongoing effort to integrate innovative solutions into educational practices.

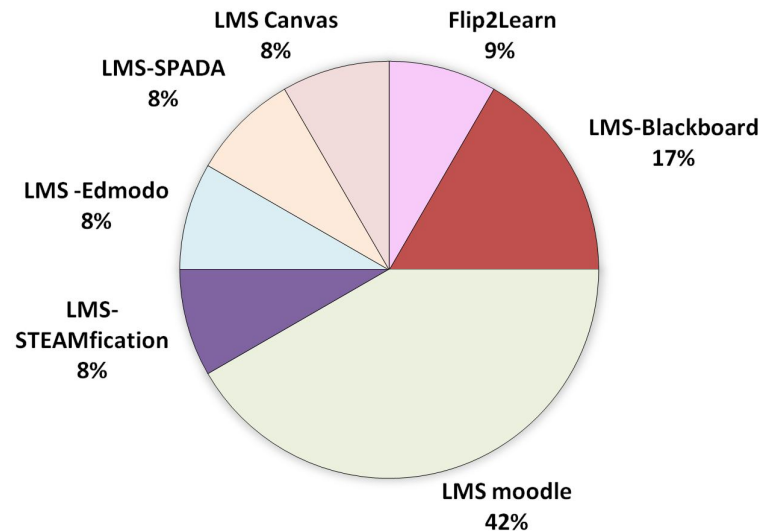


Figure 9. Learning management systems reported in the analyzed articles about Flipped Classroom.

Learning management systems

Moodle is the most used Learning Management System reported amongst the used LMS in the flipped classroom. It is reported in 42% of the articles. Other LMSs used are Blackboard which is reported in 17%, Canvas 8%, SPADA 8%, Edmodo 8%, as well as STEAMfication which is reported in 8% of the analysed articles (Figure 9).

Learning Management Systems (LMSs) play a crucial role in the implementation of the Flipped Classroom model, offering a centralized platform for content delivery by providing a structured environment for organizing and delivering instructional content outside the traditional classroom. Educators can upload pre-recorded lectures, readings, and multimedia materials, allowing students to access the content at their own pace before in-person sessions (Tucker, 2012). This asynchronous access fosters flexibility, accommodating diverse learning styles and schedules.

LMSs also facilitate interactive elements crucial for the Flipped Classroom model. Discussion forums, chat features, and collaborative tools within the platform enable students to engage in meaningful online discussions, share resources, and collaborate on projects (Brame, 2013). This collaborative aspect aligns with the emphasis on higher-order thinking skills during in-person sessions. The assessment features of LMSs support both formative and summative evaluation. Educators can design quizzes, assignments, and assessments to gauge students' understanding of the pre-class materials (Tucker, 2012). Timely feedback can be provided, guiding students' preparation for in-class activities and reinforcing the self-directed learning aspect of the Flipped Classroom.

LMSs often include analytics tools that allow educators to track student engagement and progress. This data can inform instructional decisions, enabling personalized interventions to address individual learning needs (Hinojo-lucena et al., 2018). The adaptive nature of LMSs aligns to cater to diverse student abilities and enhance overall learning outcomes. The use of an LMS provides a scalable solution for institutions implementing the Flipped Classroom model across various courses and disciplines. It allows for standardized content delivery, assessment practices, and tracking of student performance, contributing to a cohesive and institution-wide approach (Brame, 2013). The use of LMSs in a flipped setting has significant implications for both educators and learners.

Visual displays

Figure 10 shows that videos are the major visual display, which is reported in 76.5% of the analysed articles. On the other hand, texts are reported in 32.4%. Both texts and videos are the main visual displays according to the reports analysed.

In the context of the flipped classroom model, the strategic use of various visual displays plays a pivotal role in enhancing the learning experience and outcomes for students. Visual displays, ranging from traditional tools like PowerPoint presentations to more interactive platforms, contribute to the pre-class content delivery phase, fostering a deeper understanding of the subject matter. Research indicates that well-designed visual aids can improve comprehension, retention, and engagement among students (Mayer, 2009). Visual displays are instrumental in conveying complex

information effectively, catering to diverse learning styles. For instance, infographics, diagrams, and multimedia elements can provide a visual representation of abstract concepts, making them more accessible to learners (Hattie, 2012). Moreover, incorporating interactive visual displays, such as virtual labs or simulations, aligns with the constructivist principles of

the flipped classroom, encouraging active exploration and experimentation. As educators explore the potential of visual displays in the flipped classroom, it becomes evident that thoughtful integration of these tools not only facilitates content delivery but also cultivates a dynamic and participatory learning environment.

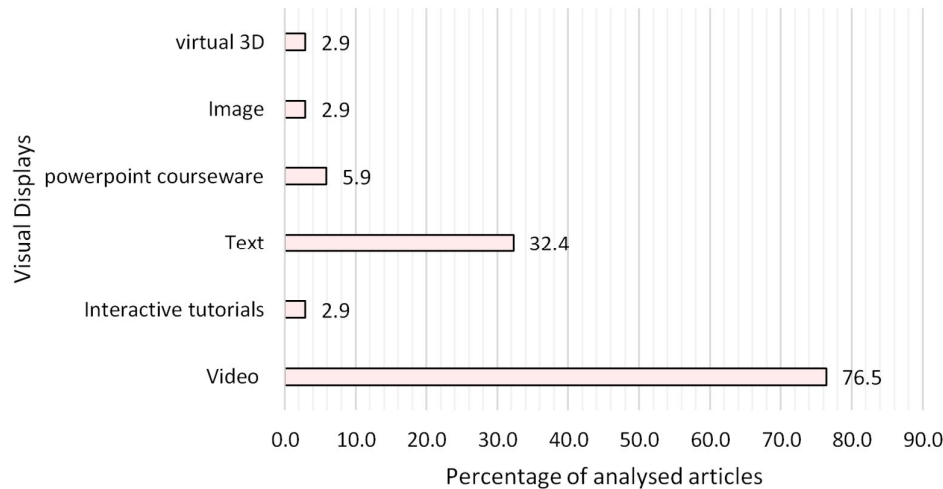


Figure 10. Visual designs reported in the analyzed articles about Flipped Classroom.

In the realm of the flipped classroom model, the use of videos plays a pivotal role, offering both a dynamic means of content delivery and a catalyst for active student engagement during in-class sessions. The pre-class phase typically involves the creation or selection of instructional videos, which students can access at their own pace. These videos serve as a foundational source for acquiring basic knowledge and understanding of concepts, enabling learners to arrive at in-person sessions well-prepared (Tucker, 2012). Videos, as a visual and auditory medium, cater to diverse learning styles, making educational content more accessible to a broad range of students in-class time, liberated from traditional lecturing, then becomes an arena for collaborative activities, discussions, and problem-solving, capitalizing on the groundwork laid by the pre-class videos.

One of the advantages of using videos in a flipped classroom is that it offers the opportunity for learners to access lecture videos whenever and wherever they are available, and they can learn at their own pace (Fulton, 2012). Therefore, the implications of using videos in flipped classrooms are twofold: students engage with content at their own pace, fostering a personalized learning experience. While educators utilize in-person sessions for higher-order thinking activities, promoting critical analysis and application of knowledge (Bishop and Verleger, 2013). Though it was observed that video usage in flipped classrooms is beneficial for students, some suggestions for using lecture videos in the flipped classroom were reported in the literature. These include but are limited to the improving quality of instructional

videos, and lecture videos also should provide more knowledge about the course being learned (Thi Kim Loan, 2021). Therefore it is advised for instructors to take into consideration the limitations as far as video usage in flipped classrooms is concerned.

Outcomes of flipped learning research between 2018 and 2023 in terms of student learning

In an attempt to answer the fourth research question regarding the outcomes of flipped learning research between 2018 and 2023 in terms of student learning, a content analysis of the selected papers was carried out. The analysis revealed that students' satisfaction and academic performance and achievement were the learning outcomes mostly measured in flipped classroom research. Other outcomes include but are not limited to students' engagement, and perception of flipped classroom. The learning outcomes found in this analysis are summarized in Figure 11.

Academic performance and achievement were major learning outcomes reported in 53% of the analysed articles about the flipped classroom research with a positive impact. Similarly, in the literature, Zou et al. (2020) results also support this finding suggesting the Academic performance of students was the primary focus of flipped learning research. The second most learning outcomes mostly researched is students' satisfaction and engagement which concur with the findings reported by Bond (2020).

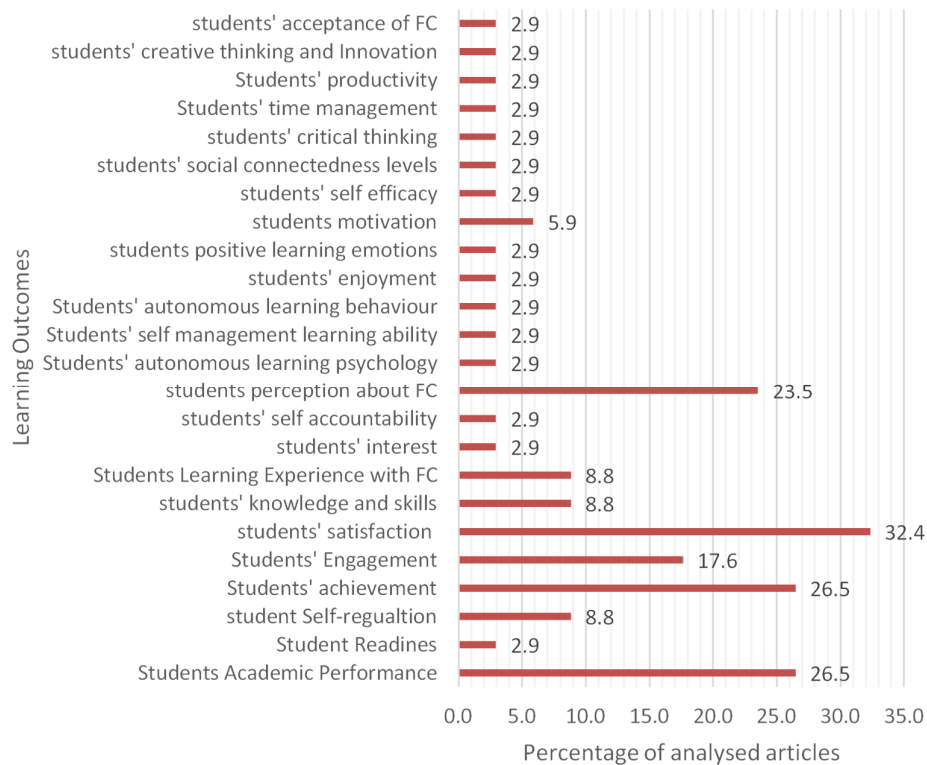


Figure 11. Learning outcomes mostly measured in flipped classroom research in higher education.

All these outcomes are reported to be positively impacted by flipped classrooms. For instance, a study on a group of university students in science subjects by Butt (2014) discovered that students responded favorably to the Flipped Classroom, which was introduced. Mason et al. (2013) focused on the information and discovered that the pupils can cater to additional information in that field. When compared to pupils in traditional classes, students who receive instruction in flipped classrooms are also more adept at solving complex problems. Similarly, according to Gianoni-Capenakas, (2019) and Zou et al. (2020), the flipped classroom had a beneficial influence on motivation and views of the flipped learning strategy. Specifically, in their studies of academic achievement, cognitive domain as well as affective domain. Zou et al. (2020) suggest that flipped learning had the greatest influence on engagement, which is consistent with the findings herein reported.

The combination of Flipped Classroom with team-based learning is predicted to improve active learning in blended learning environments (Demetry, 2010). Zhang (2014) employed Flipped Classroom while teaching Graph and Image Processing which are one of the university's elective disciplines. The findings indicated that implementing the Flipped Classroom can help students learn difficult subjects more easily. Furthermore, the installation of the Flipped Classroom allows students to submit more questions to lecturers that they did not understand.

Student engagement and motivation and student self-regulation are other learning outcomes respectively reported in the 23.5 and 8.8% of the articles analyzed.

These learning outcomes were reported to be impacted positively by the flipped classroom model. Self-direction skills are crucial for online learning medium because students have greater control, independence, and accountability in their learning processes than in face-to-face learning situations (Koçdar, 2015). Studies have reported the existence of a relationship between self-directed learning and achievement. Students with better levels of self-directed learning skills obtain higher levels of knowledge acquisition and management. Salas (2010) reported that online courses in higher education and distance learning programs are regarded as critical milestones in promoting self-learning. Flipped learning, which encourages students to take greater control over their learning and has an Internet dimension, can help students engage in self-directed learning more effectively by giving them independence and flexibility (Şahin, 2010).

On the other hand, the flipped classroom model requires students to manage and maintain motivation for both implementing self-directed learning and enabling students to manage their learning processes. Student motivation is an important prerequisite for managing their learning process (Boevé et al., 2016). Motivation drives people to exert effort, and self-directed students should exert effort in their learning process. As a result, motivation is required for self-directed learning. More motivated students have better degrees of self-directed learning skills. As a result, motivation is an important factor to consider in the learning environment. Learning settings that propel students forward, in which students demonstrate their abilities, expose their values, and

experience success and failure, can have an impact on motivation (Ünsal, 2012). Recently, it has been reported that Student motivation is a crucial aspect of enhancing achievement in educational environments that have evolved in response to technological advancements (Boevé et al., 2016). Studies have concluded that web-based learning, online learning, and blended learning environments, which became part of the educational process along with technology, impact student motivation.

Amongst learning outcomes reported include perception and satisfaction about Flipped Classroom which are respectively reported in 23.5 and 32.4% as well as students' learning experience with Flipped Classroom at 8.8%. According to reports analyzed, the flipped classroom has a positive impact on these learning outcomes. Students have loved studying with this teaching technique. Talan and Gulsecen (2019) reiterated that the flipped classroom has positive effects on the students' academic achievements and engagement. They are more involved in academic engagement and generally satisfied with this model of learning. All in all, the results of our systematic review regarding the positive influence of flipped learning on learning outcomes herein discussed are also similar to the findings reported by Birsgili et al. (2021).

The implication of the use of flipped classrooms according to the finding herein reported, is that the new pedagogical approach should be used more frequently in higher learning institutions, and applies to almost all subjects taught in universities. This finding is also supported by Flumerfelt and Green (2013) for the implementation of new methods, such as an ongoing

Flipped Classroom. The study also showed an increase in the percentage of students who passed Mathematics, Science, English and Social Sciences papers after implementing Flipped Classroom. According to Flumerfelt and Green (2013), a different approach, from the point of changes in school curriculum should take place, to ensure that the school curriculum moves in tandem with 21st-century learning. Therefore, curriculum needs the brave changes and research on teaching and learning must be done continuously.

Implementation of new pedagogical methods such as Flipped Classroom, however, needs a brief explanation of the implementation procedure to the students. Students should be given an explanation of Flipped Classroom before implementation starts to avoid any unpleasant feelings and emotions among students. In addition, an explanation of Flipped Classroom before the implementation process can also prepare students to accept a new approach.

Challenges encountered in flipped classroom implementation

Though in the majority of the reports analyzed flipped classroom was reportedly beneficial as far as learning is concerned, few reported challenges associated with the use of FC as well. The challenges reported are summarized in Table 3. These challenges were categorized into four categories namely: Technical challenges, Motivation and behavioral challenges, Content-related challenges, and Learning-related issues.

Table 3. Challenges reported in analysed flipped classroom research.

Category	Challenges	References
Technical challenges	Inadequate video recording and editing skills for instructors	Umam and Mulyono (2019), Xiao-dong and Hong-hui (2020)
	Lack of experience in using ICT tools for students	Alamri (2019)
	Finding information from reliable websites	Alamri (2019)
	Difficulties in opening links	Afzal and Masroor (2019)
Motivation and behavioral challenges	Need for training	Hoshang et al. (2021)
	Minimal interactions between teachers and Students	Xiao-dong and Hong-hui (2020)
	Lack of extra time for instructors to prepare Flipped Classroom learning materials and support teaching	Xiao-dong and Hong-hui (2020)
	The reluctance of instructors and students to adapt to new roles	Xiao-dong and Hong-hui (2020), Lopes and Soares (2018), Díaz et al. (2021)
Content related challenges	Need for students to learn time management self-control and commitment to education	Lopes and Soares (2018), Hoshang et al. (2021)
	Some videos are unconcise and monotonous	Afzal and Masroor (2019)
	The presence of more homework than in the traditional mode of learning	Alamri (2019)
	Topic difficulty and presence of many terms	Cabı (2018)
	Insufficient resources	Cabı (2018)
Learning-related issues	Feeling that Flipped Classroom is suitable for the theoretical part of the lesson, not the practical part.	Hoshang et al. (2021)
	Lack of time to study or watch videos	Alamri (2019), Cabı (2018)
	Absence of the facilitator while watching the video only to rely on peer students	Afzal and Masroor (2019), Gomez-lanier (2018)

The implementation of the Flipped Classroom model, while promising for student engagement and learning outcomes, is not without its challenges. Amongst the challenges found include behavioral issues such as lack of time. These time constraints affect both students' engagement with pre-class materials and instructors to create and curate these resources. Recent research suggests that students often struggle with finding dedicated time for pre-class study or video-watching, especially when faced with heavy academic workloads and other commitments (Chen et al., 2020). This challenge necessitates a careful consideration of the length and complexity of pre-class materials, emphasizing brevity and clarity to accommodate students' busy schedules.

Another challenge associated with the Flipped Classroom model lack of self-control, and time management skills. The autonomy granted in a flipped setting requires students to take charge of their own learning, a responsibility that may be challenging for those who have not yet developed effective self-regulation skills (Abeysekera and Dawson, 2015). Failing to do so, may lead to the incompleteness of work and hence learning may not be as effective as it was anticipated. Hockly and Dudeney (2017) have reported similar challenges of flipped learning, involving unfinished work, effective self-regulation, technology problems, and learner and teacher expectations. Moreover, Bristol (2014) reported that Some students arrive to class unprepared and study lecture videos at home before class. This prohibits the flipped technique from being successfully implemented. Another barrier is learners' reluctance to transition from teacher-centered language learning approaches to flipped classrooms because they believe the workload will increase (Kostka and Marshall, 2017). In response, educators implementing the Flipped Classroom should consider integrating explicit guidance on time management and self-regulation into their instructional design, perhaps through orientation sessions or ongoing support throughout the course. It is advised that any changes in teaching and learning approaches should be made known to students.

Many issues will develop if learners in the flipped classroom do not complete prescribed homework, create their own learning goals, manage their time properly, and choose appropriate learning materials. Furthermore, learners' online learning is influenced by a lack of appropriate devices (tablets, laptops, etc.), reliable Internet connections, and basic computer skills. When creating their own instructional materials, teachers face challenges with IT skills, digital tools, and hardware (Kvashnina and Martynko, 2016). Moreover, it is recommended that school administrators train teachers early in the transition to assist them in overcoming concerns about new technology abilities and unfavorable attitudes toward increasing workload.

Another challenge lies in students' struggle to create their own learning goals. Autonomy in goal-setting is a fundamental aspect of the Flipped Classroom model, yet some students may lack the experience or skills to set realistic and effective learning objectives. Supporting

students in goal-setting through guided exercises, workshops, or mentorship can enhance their ability to articulate and pursue meaningful learning goals (Mason et al., 2013). Furthermore, the challenge of choosing appropriate learning materials can be addressed by providing students with clear guidelines on reliable sources, encouraging collaborative exploration, and fostering a culture of information literacy. Educators should communicate expectations regarding the quality and relevance of learning materials to ensure that students engage with resources that align with the course objectives.

To address these challenges, potential solutions can be implemented. Instructors can enhance the accessibility of pre-class materials by providing them in various formats, such as concise videos, annotated readings, or interactive online modules. This caters to diverse learning preferences and accommodates students with limited time availability. Additionally, educators can foster a culture of responsibility and time management by incorporating explicit instructions on study strategies and self-regulation skills within the course structure (Strayer, 2017). Institutions can support these efforts by offering workshops or resources on effective time management to help students develop these essential skills.

In conclusion, while the Flipped Classroom model offers numerous benefits, the challenges herein reported such as students' inability to complete homework, set learning goals, manage time effectively, lack of self-control, choose appropriate materials, and many more are not insurmountable. They can be mitigated by employing various strategies such as tailoring pre-class assignments to be more manageable, offering support in goal-setting, providing explicit guidance on time management, and promoting information technology literacy. By doing so educators and institutions can pave the way for a more successful and student-centered implementation of the Flipped Classroom model. Hence helping students overcome these challenges and fully embrace the opportunities for self-directed learning presented by the Flipped Classroom model.

CONCLUSION

This study aimed to undertake a review of published scientific literature on flipped classroom usage in higher learning instruction. Using a consistent search approach and established criteria for article selection, 34 peer-reviewed journal articles were found and analysed using indicative content analysis techniques. According to the analyzed sources, the trends in flipped learning studies reveal that this strategy is highly beneficial. Traditional educational systems have given way to non-traditional, technology-based approaches, with flipped learning playing an important role in this change. Students favor the implementation of active learning techniques in the classroom. According to studies, the flipped classroom has a good impact on students' achievement, motivation, engagement, and self-regulation. The findings of this study revealed that students had positive opinions of the

flipped classroom. It is critical to focus more on the difficulties and experiences of teachers to improve the effectiveness of the flipped learning approach. Furthermore, the effectiveness of course videos which is dependent on their quality, is an important aspect of the success of flipped learning. As a result, additional research in this area is required. Furthermore, as shown in the research, there were some disadvantages to flipped learning. More research is needed on these topics, particularly the video production challenges. The effectiveness of flipped learning supports our conclusions and assertions that full-fledged schools, rather than just one or two flipped courses or classrooms, would be beneficial for new educational paradigm shifts.

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