Students' engagement challenges in the pre-class phase of flipped classrooms: A systematic review

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The flipped classroom is an active learning approach that shifts instruction from traditional lecture-based methods to student-centred learning, emphasising pre-class preparation. The pre-class component is a crucial element of the flipped classroom model; however, several studies have reported challenges that students face with engagement in the pre-class component. This study conducted a systematic review to explore the challenges hindering student engagement, analysed from the perspectives of students, teachers and institutions. The review covered journal articles published between 2020 and 2025 from four databases: Scopus, Web of Science, Wiley and ERIC. Findings reveal that students face key challenges such as engagement with pre-class videos, autonomous learning and emotional barriers. Teachers' primary concern lies in designing high-quality instructional videos that foster student engagement, while institutional challenges centred on inadequate technological infrastructure for implementing the flipped classroom model. This study presents a taxonomy of challenges, proposed adoption practice and policy for practitioners to consider when adopting the flipped classroom approach.

Implications for practice or policy:

- Flipped classroom practitioners and researchers should prioritise engaging pre-class learning activities, as effective preparation strongly influences successful in-class learning.
- Teachers should be supported in developing high-quality instructional videos and interactive pre-class materials that sustain learner engagement.
- Educational institutions should invest in flipped classroom technological infrastructure, teacher training, instructional design support and digital tools to enhance effective implementation of flipped classroom model.

Keywords: higher education, flipped classroom, online learning, learning engagement, systematic review

Introduction

Over the past 2 decades, technology integration has transformed education by making learning more flexible, accessible and scalable, leading to the emergence of blended learning (Rasheed et al., 2020). Blended learning combines face-to-face and online instruction (Garrison & Kanuka, 2004), offering benefits such as flexibility, increased interactions and support to diverse learners (Dziuban et al., 2018).

A prominent evolution of blended learning is the flipped classroom model — a student-centred instructional approach where students engage with instructional content, such as videos or digital modules, before class. Class time is then repurposed for collaborative discussions, active learning and applied problem-solving (Tucker, 2012). This shift promotes self-directed learning and better knowledge application under the guidance of instructors. The model has been widely adopted across disciplines such as science, technology, engineering and mathematics, medicine and the humanities, reflecting its growing influence in contemporary pedagogy (Akçayır & Akçayır, 2018).

Conceptually, the flipped classroom is grounded in constructivist learning theory (Zajda, 2021, Chapter 3), which emphasises active knowledge construction through interaction, reflection and social engagement. By reallocating lower-level cognitive tasks (e.g., remembering and understanding) to pre-class activities and reserving classroom time for higher-level cognitive processes (e.g., applying, analysing and evaluating), the flipped classroom aligns closely with Bloom's revised taxonomy (Krathwohl, 2002). This structure is intended to promote learner autonomy, flexibility in learning pace and more meaningful interactions between students and instructors (Al-Samarraie et al., 2020).

As flipped classrooms are emerging as a dominant instructional approach globally, the pre-class stage remains a critical component of the model, which significantly influences the success of in-class activities. Pre-class learning allows students to acquire foundational knowledge at their own pace and revisit content as needed, enabling more meaningful in-class engagement (Chen et al., 2014). However, despite these advantages, concerns persist regarding the overall effectiveness of flipped learning. Many students do not fully engage with pre-class materials, resulting in unproductive in-class sessions and reduced learning outcomes (Abd Rahman et al., 2021). This disengagement is typically rooted in students' lack of meaningful engagement with instructional videos and preparatory materials before attending face-to-face sessions (Lee & Choi, 2019). While the primary goal of the flipped classroom model is to foster student-centred and active learning, achieving this remains a challenge.

Research has shown that students often experience boredom, low motivation and insufficient engagement across cognitive, emotional and behavioural dimensions (Li & Li, 2022; Lo & Hew, 2022; Ng, 2023; Shen, 2024), insufficient lecturer support (Kong et al., 2024) and technological barriers (Han 2022; Mujtaba Asad et al., 2022). Such disengagement undermines the model's core promise – to promote deeper, active learning during in-class sessions. Unlike blended learning, which often emphasises self-regulation, the flipped classroom places a stronger emphasis on engagement with pre-class resources, particularly teacher-prepared videos. Several studies and scholarly assertions have suggested that strengthening student engagement in the pre-class component of flipped classrooms, or mitigating barriers to pre-class disengagement, has a direct and positive influence on in-class activities and the overall effectiveness of the flipped classroom model (Akçayır & Akçayır, 2018).

Furthermore, teachers also encounter challenges, including uncertainty about the level of pre-class support to provide, limited familiarity with best practices, difficulty transitioning from teacher-centred to student-centred approaches and, in some cases, limited competence in using modern technology for flipped classroom delivery (e.g., see Baig & Yadegaridehkordi, 2023; Colomo Magaña et al., 2022; Kazeminia et al., 2022; Utami et al., 2024). On an institutional level, many educational institutions face difficulties in providing the necessary technology, infrastructure and professional development to fully support both teachers and students in the pre-class and in-class phases.

Clearly, this study sought to address these gaps by systematically reviewing literature on flipped classroom engagement challenges from the perspectives of students, teachers and educational institutions. It identified the barriers and limitations of current approaches, examined the role of teachers in fostering pre-class engagement and explored how technological innovations – particularly personalised learning frameworks – can enhance active participation and learning in both online and flipped classroom environments.

Methodology

The following research questions (RQs) guided our research:

- RQ1: What challenges hinder students' engagement with the pre-class phase of flipped classrooms?
- RQ2: What are the challenges that teachers face with the pre-class phase of flipped classroom?
- RQ3: How do educational institutions use technology to support student engagement in the pre-class phase of flipped classrooms, and what challenges do they encounter?

Literature search

This study analysed flipped classroom articles published in Social Science Citation Index journals from 2020 to 2025, using the Web of Science database, selected for its comprehensive indexing of Social Science Citation Index and Science Citation Index journals. The search, conducted from December 2024, was informed by prior review studies (Akçayır & Akçayır, 2018; Rasheed et al., 2020).

A search string combining "flip*" and "invert*" with the Boolean operator "OR" was used to capture variations such as "flipped" and "inverted" classrooms. Results were refined by publication year (2020–2025) and relevant research areas, including educational research and educational psychology.

Additionally, related studies from computer science were examined to provide insights into student engagement, emotions, and instructional video design in the pre-class phase, forming a foundation for addressing the study's RQs.

Eligibility criteria

For this study, the inclusion criteria framework consisted of only articles that defined flipped classrooms in educational settings, consisting of both pre-class and in-class components. The flipped classroom had to be the central topic of the article, and only empirical studies were included. The exclusion criteria primarily involved book chapter reviews, non-English articles and articles for which the full text was unavailable.

This approach guided the study's focus. An inductive thematic coding method was used to identify empirically supported engagement challenges, with codes refined collaboratively to resolve overlaps and ambiguities, while excluding unsupported claims from non-empirical sections. To ensure methodological rigor, we adopted the PRISMA recommendation statement (Moher et al., 2009), which provides a structured overview of the search protocol for conducting systematic reviews. This process is depicted in Figure 1.

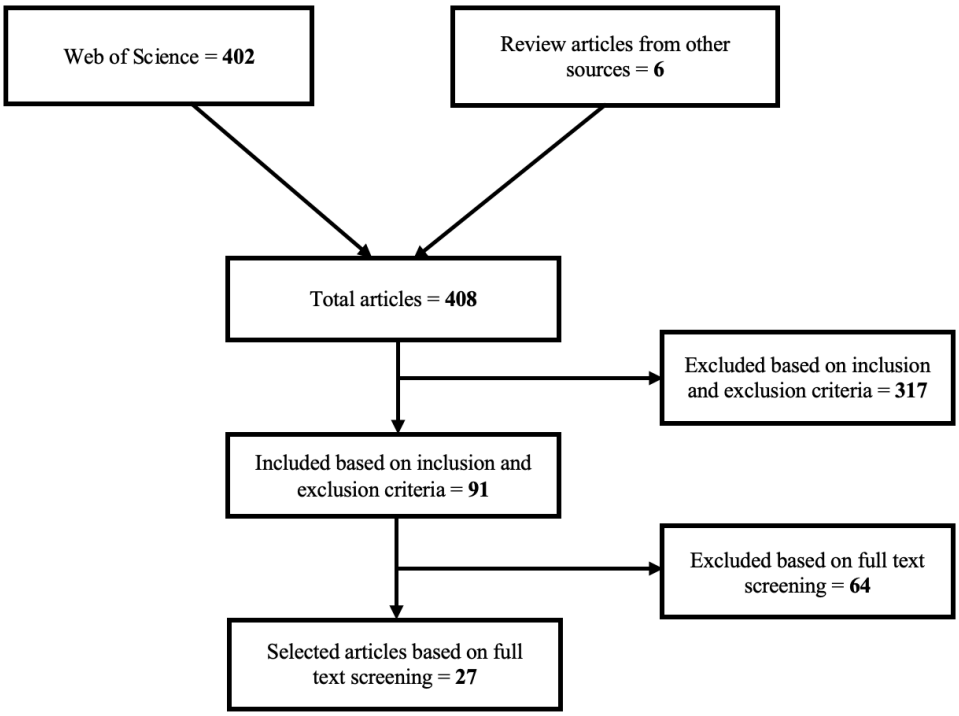

Figure 1. An overview of the search protocol based on the preferred reporting items for systematic reviews and meta-analyses (PRISMA) recommendation statement

Results

This section answers the RQs of this study by reporting and discussing the engagement challenges that students face in their pre-class phase of flipped classrooms.

RQ1: What challenges hinder students' engagement with the pre-class phase of flipped classrooms?

Table 1
Pre-class students' challenges

Reported challenge	Reference
Theme 1: Learning with video	
Poor video quality	(Mujtaba Asad et al., 2022)
Difficulty understanding video content	(She, 2024)
Long and boring video lectures	(Utami et al., 2024)
Inability to ask questions during video lectures	(Cortez et al 2023)
Lack of realism compared to face-to-face teaching	(Sun et al., 2023)
Anxiety when learning with video	(Shen, 2024)
Difficulty engaging with pre-class videos	(Mikek, 2023)
Theme 2: Technological challenges	
Limited Internet access	(Han, 2022)
Technical problems during pre-class activities	(Han, 2022)
Digital divide among underprivileged students	(Mujtaba A et al, 2022)
Lack of access to digital tools	(V. Aidoo et al., 2022)
Network connectivity issues	(Sun et al., 2023)
Internet quota limitations	(Fidan & Fidan, 2024)
Theme 3: Emotional feelings	
Learning anxiety and nervousness	(Li & Li, 2022)
Negative emotions due to unfamiliarity	(Lo & Hew, 2022)
Feelings of loneliness	(Sun et al., 2023)
Restlessness during pre-class learning	(Shen, 2024)
Theme 4: Time-consuming and heavy workload	
Excessive pre-class workload	(Baloch et al., 2022; Li & Li 2022)
Increased pre-class workload	(M. Aidoo et al., 2022)
Poor time management	(Bitzenbauer & Hennig, 2023)
Insufficient time to watch videos	(Utami et al., 2024)
Waste of time in video-based discussions	(Fidan & Fidan, 2024)
Work overload from self-directed learning	(Aljaber et al., 2023; Hao & Lan 2023)
Theme 5: Autonomous study and collaborative learning	
Difficulty with autonomous learning	(Kazeminia et al., 2022)
Low self-discipline in pre-class tasks	(Kong et al., 2024)
Reluctance to complete pre-class tasks	(Seidi, 2024)
Difficulty completing individual pre-class tasks	(Kong et al., 2024)
Limited peer interaction	(V. Aidoo et al., 2022)
Delayed instructor feedback	(Kong et al., 2024)
Reduced live communication skills	(Vdovinskiene, 2023)

Based on the findings presented in Table 1, the first thematic category that emerged from the reviewed literature concerns student-reported engagement challenges associated with learning with video in the pre-class phase of flipped classrooms. Such challenges arise from difficulties in engaging with video content, alongside limitations associated with autonomous online learning environments.

Students' comprehension of video content is crucial for effective face-to-face classroom activities in flipped learning. While students generally express a positive attitude towards videos and video watching (Shen, 2024), engaging them in pre-class instructional videos has remained a pedagogical challenge (Beatty et al., 2019; Nielsen, 2020). Instances of students skipping video content, binge-watching before assignments and tests or ignoring videos are not uncommon in flipped literature. Student perception of and behavioural engagement in video watching are often examined as indicators of student engagement in flipped learning (Akçayır & Akçayır, 2018). Research has indicated that students are selective when watching instructional videos (Shen, 2024), and they tend to base their viewing decisions on their perceived importance of video content (Nielsen, 2020). However, findings are mixed in terms of what constitutes important content. Tse et al., 2019 have reported that disciplinary differences may affect students' perception of what is important to learning, while learner proficiency is another influencing factor.

Technological approaches for engaging students with pre-class video

Several empirical studies have examined how video design and production decisions influence student engagement in online educational videos across various research domains (e.g., Guo et al., 2014; Lackmann et al., 2021; West & Turner, 2016). In fact, the influential study by Guo et al. (2014) provided a foundational framework for creating engaging educational videos, recommending, for instance, that "shorter videos are much more engaging" and advising educators to "invest heavily in pre-production lesson planning to segment videos into chunks shorter than 6 minutes" (Guo et al., 2014, pp. 44–46).

In the context of flipped classrooms, there have been relatively few technological approaches specifically aimed at engaging students with pre-class videos. For example, Förster et al. (2022) have demonstrated that the timing of when students watch pre-class videos significantly influences long-term learning outcomes and academic performance. Their findings suggest that watching pre-class videos in a timely manner – aligned with the flipped classroom model – is a critical determinant of learning success, outweighing the sheer quantity of video consumption. While the study did not directly measure engagement with pre-class videos, it interestingly assessed learning achievement and knowledge retention in relation to the timing of video viewing. Shaw et al. (2022a, 2022b) monitored student engagement using electroencephalogram signals by tracking students cognitive state as students watched pre-loaded video lectures. Their follow-up study (Shaw & Patra, 2022b) went further by recommending personalised videos tailored to individual cognitive states. However, both studies primarily focused on in-class engagement and did not specifically target pre-class engagement in flipped learning environments.

Another notable study, by Huang et al. (2023), introduced an artificial intelligence-enabled personalised video recommendation system for flipped classrooms, examining its impact on student motivation, engagement and academic performance. Although the system allowed students to access personalised video content at any time, the research did not concentrate specifically on pre-class engagement. Engagement was quantitatively assessed through student activity data within a learning management system. It is evident that students in flipped classrooms have often lacked access to the high-quality, engaging video content recommended by foundational studies such as that by Guo et al. (2014).

Technological challenges

Over the past 2 decades, research has highlighted the persistent issue of the technological divide, particularly affecting students from less privileged communities who lack access to adequate Internet or technological infrastructure. The challenge of technology use has remained prevalent for various reasons (e.g., see Akçayır & Akçayır, 2018; Rasheed et al., 2020). Our study reveals that the primary technological challenges stem from inadequate access – such as outdated devices or unreliable Internet connectivity—particularly among students in remote or less privileged areas, rather than a lack of technological competence.

Emotional feelings

The third categorical theme identified in Table 1 concerns student-reported challenges related to negative emotional responses. These include learning anxiety and nervousness arising from the interactive nature of flipped learning and the perceived additional workload, as well as heightened anxiety associated with

video-based learning. Students also reported restlessness, fatigue and boredom, particularly when engaging with lengthy video lectures.

Anxiety and boredom

One of the standouts and common theme that students have experienced and that have negatively affected their pre-class learning engagement is anxiety. Researchers have used the term reducing anxiety and have put forth or proposed strategies for reducing anxiety in learning contexts such as changing the learning situation, to reduce stress by redefining the task or by modifying the social interactions, changing the anxious person's reaction by desensitisation (Sieber et al., 2013). Alrabai (2015) identified anxiety-reducing strategies targeting key sources of learning anxiety in the in-class phase of flipped classrooms, including fear of negative evaluation and communication apprehension in language learning settings. Nearly all of these studies have identified the flipped classroom teacher as a central pillar in the effective implementation of flipped learning strategies.

When boredom is mentioned, it is largely regarded as a neutral state that implies a lack of enjoyment or interest (Pekrun, 2010). Thus, boredom is usually overlooked in educational settings due to its non-disruptive and inconspicuous nature compared to emotions such as anger and anxiety (Pekrun et al., 2010). Research on emotions has increased, attracting interest from researchers, but boredom, especially boredom reported in educational settings (Nett et al., 2011; Pekrun et al., 2010), has scarcely been researched and is continuously overlooked. Boredom has been linked to poor academic performance in educational settings and can lead to detrimental learning outcomes (Pekrun et al., 2010).

Psychologists usually characterise or look at boredom as stemming from two causes: internal causes, in the form of personality, and external causes, which comprise task and environmental influences (e.g., see Farmer & Sundberg, 1986; Fisher, 2018; Vodanovich, 2003). Researchers have suggested that boredom, from an external perspective, stems from a lack of stimulation within the task environment. Accordingly, several studies have argued that only learning situations that are not perceived as boring can be considered genuinely effective learning experiences (Kanevsky & Keighley, 2003; Mann & Robinson, 2009; Tze et al., 2016; Vodanovich, 2003).

Measuring emotions using machine learning technologies

Researchers in computer science discipline have studied and proposed approaches for measuring and detecting emotions in online learning contexts primarily using facial gestures (Dollmat & Abdullah, 2022; Elbawab & Henriques, 2023; Fang et al., 2023; Sharma et al., 2022; Villegas-C et al., 2023) and cues with machine learning techniques and deep learning (e.g., see Dukić & Sovic Krzic, 2022; Mohamad Nezami et al., 2019). Among classical machine learning algorithms used to detect and measure emotions, support vector machine is the most frequently applied, followed by neural network-based approaches (Khare et al., 2024). Therefore, research efforts in applying and implementing machine learning for measuring and providing emotional scaffoldings for students are still in their infancy.

Time-consuming and heavy workload

One recurring theme reported by students in flipped classrooms is the heavy workload associated with pre-class activities. As shown in the findings presented in Table 1, students frequently reported challenges related to the time-consuming nature of pre-class tasks, which often hindered their engagement with flipped classroom instruction, and complained about the need to reduce their pre-class component tasks (Khasanah & Anggoro, 2022) due to its being excessive (Hao & Lan, 2023). This finding might be obvious and unsurprising because the flipped classroom is a blended learning instructional strategy that focuses on student-centred learning and promotes active learning.

Arguably, the use of technology, or the role of technology, is greater in flipped classrooms compared to traditional blended learning. This is due to the requirement for students to watch and learn most of their new concepts using the pre-class videos. Similarly, teachers spend more time engaged with technological tools such as computers, video content software and video editing on their computer systems.

Conceivably, the flipped classroom should be seen as an instructional approach that pushes the boundaries or limits of learning, commitment and engagement, which is often perceived as an extra burden, workload or additional time – thus being time-consuming. Since students are usually required to learn new concepts or topics in their pre-class with the use of online videos, they might need to watch the video several times until they understand the concept, thus the perception that the flipped classroom and the pre-class component are time consuming and entail a heavy workload. This is why the flipped classroom model requires the use of technology to engage students in collaborative or peer learning, supported by their instructors to encourage active participation with pre-class learning materials and peer discussions, ultimately alleviating the perceived workload.

Autonomous study and collaborative learning

Studies shown in Table 1, such as those of Kazeminia et al. (2022), Kong et al. (2024), Seidi et al. (2024) and Vdovinskienė (2023), have reported students' reluctance to learn and engage with pre-class learning materials, particularly videos. Kong et al. (2024) have also highlighted the persistent problem of students' inability to interact with peers or receive prompt feedback from their teachers after completing independent online learning activities or watching online videos. While some researchers (e.g., Lin et al., 2021; Schlag et al., 2024) have called for immediate online feedback or opportunities for peer discussion, our review of the literature revealed that this issue has received scant attention.

The lack of peer interaction and collaborative learning opportunities contributes to students' learning difficulties (Rasheed et al., 2021). Studies have shown that students with poor self-regulation skills, limited self-directedness and challenges in autonomous learning often fail to engage with learning materials during pre-class sessions. This, in turn, negatively impacts their in-class participation and overall academic performance, which has hindered the effectiveness of online and autonomous learning over the years (Rasheed et al., 2021). However, research has yet to firmly assert who bears full responsibility for ensuring collaborative learning in the pre-class component. Is it the responsibility of teachers to facilitate student collaboration, as the literature on flipped learning suggests (e.g., see Chen et al., 2025; Hew & Lo, 2018; Kim et al., 2014; Zhao & Li, 2021), or is it the students' responsibility to initiate such learning strategies themselves? Research on technologies and systems that support peer learning and collaborative learning has gained increasing attention post the COVID-19 pandemic, after years of relative neglect in this area (Rasheed et al., 2021).

RQ2: What are the challenges that teachers face with the pre-class phase of flipped classroom?

Table 2
Teachers' challenges with the pre-class

Reported challenge	Reference
Theme 1: Training and technological competencies	
Low digital competence of teachers	(Colomo Magaña et al., 2022)
Inadequate training in flipped classroom pedagogy	(Han, 2022)
Limited technological competence	(M. Aidoo et al., 2022)
Difficulty adopting student-centred teaching approaches	(Wang et al., 2022)
Theme 2: Increased workload	
Increased teaching workload	(Lo & Hew, 2022)
Time-consuming pre-class preparation	(Baig & Yadegaridehkordi, 2023)
High effort in developing course materials	(Kazeminia et al., 2022)
Extensive time spent on preparation	(Utami et al., 2024)
Theme 3: Video design challenges	
Designing and recording instructional videos	(Liu et al., 2024)
Difficulty sourcing high-quality teaching resources	(Wang et al., 2022)

Reported challenge	Reference
Lengthy and poorly designed videos	(Chung et al., 2024)
Technical issues affecting video delivery	(Chung et al., 2024)
Theme 4: Ineffective communication between teachers and higher institutions	
Ineffective institutional communication	(Lo & Hew, 2022)
Theme 5: Technological insufficiency	
Limited access to digital devices	(Senali et al., 2022)
Limited internet access	(Senali et al., 2022)
Device compatibility issues	(Chung et al., 2024)

Training and technological competencies

As shown in Table 2, the theme of challenges in training and technological competencies reflects a broader gap in teachers' readiness to transition from traditional instruction, where inadequate preparation and limited familiarity with digital tools collectively hinder their ability to effectively redesign and facilitate a student-centred flipped classroom environment.

Increased workload

As shown in Table 2, the theme of challenges in increased workload highlights the unsustainable demands placed on teachers when restructuring their pedagogical approach, where the additional burden of content creation and instructional preparation extends well beyond the boundaries of conventional teaching responsibilities.

Video design challenges

As shown in Table 2, the theme of challenges in video design underscores the complexity of transforming traditional instructional content into effective digital media, where teachers must navigate both creative and technical demands that extend beyond their conventional pedagogical expertise to ensure meaningful pre-class learning experiences.

Ineffective communication between teachers and higher institutions

The study of Lo and Hew (2022) has mentioned one of the key challenge as the lack of communication or effective communication between teachers and institution on flipped classroom, although it is not clear what is not properly communicated. However, it is most likely the challenges that flipped learning poses such as the difficulties that teachers face in creating quality instructional videos or lack of updated technology or information technology infrastructure in both hardware and software for flipped instruction.

Technological insufficiency

The study of Senali et al. (2022) reported that teachers have claimed they lack adequate access to the required technology for properly executing flipped classroom instruction.

Discussion on RQ2

Although it is not the full responsibility of students to be engaged with their pre-class videos and other learning materials outside the flipped in-class component, teachers are also responsible for motivating and scaffolding their students to be fully engaged. For example, teachers are responsible for structuring and pairing students for online collaboration, which has been a key determinant or learning strategy to engage students with their pre-class videos and other learning materials (Strelan et al., 2020). However, it is clear that teachers themselves struggle with using technology themselves, let alone using it to facilitate students' pre-class engagement. Since the flipped classroom is a student-centred learning approach, many teachers are not yet competent in mastering this model, and they prefer reverting to traditional blended learning models that preceded the flipped classroom.

A recurring theme in technology-mediated instruction is teachers' lack of technological and computer (hardware and software) competency, as well as their inability to effectively use technology for teaching (Akçayır & Akçayır, 2018; Ocak, 2011; Rasheed et al., 2020). Teachers have often been resistant to

adopting technology for educational purposes. Despite efforts by educational institutions to provide training for prospective or pre-service teachers, many still lack the proficiency and mastery needed to use technology effectively in teaching. This resistance may stem from nervousness about students being more technologically proficient, leading to teachers' fears of showing incompetence.

Another common challenge is teachers' perception that the pre-class component is too time-consuming and workload-intensive. While some have argued that this perception is exaggerated, teachers' reluctance to adapt and their limited technological competence often contribute to feelings of anxiety and boredom when using technology, making the process seem more burdensome. That said, preparing pre-class materials, such as modern videos requiring editing capabilities, can indeed be time-consuming. This process involves additional costs, training and staying updated with the latest software versions to deliver high-quality video content, especially given students' frequent complaints about low-quality videos. Wang et al. (2022, pp. 9–10) highlighted teachers' concerns about "searching for high-quality teaching resources related to course content", "environment and equipment for shooting pre-class videos", "learning new technologies to support flipped classroom teaching" and "transitioning from teacher-centred to student-centred". These four key challenges contribute to teachers viewing the pre-class component, particularly video preparation, as time-consuming and demanding.

This creates a vicious cycle. One reason for teachers' lack of enthusiasm and commitment to the pre-class component might be their belief that even if they prepare high-quality, engaging videos, there is no guarantee their students will watch, appreciate or value them. As noted in the study by Wang et al. (2022), teachers claim that students often do not watch the videos they created, which can be discouraging. This frustration is understandable, as teachers invest significant time and effort into creating high-quality content only to find it under-utilised. Additionally, teachers' lack of competence in using technology, coupled with insufficient training and proficiency, may contribute to their perception that pre-class video preparation and aligning course materials are overly time-consuming and burdensome.

RQ3: How do educational institutions use technology to support student engagement in the pre-class phase of flipped classrooms, and what challenges do they encounter?

Table 3
Educational institutions' challenges

Reported challenge	Reference
Theme 1: Cost of flipped classroom instruction	
High initial implementation cost	(Han, 2022)
High cost of instructional video production	(Han, 2022)
Expensive technological and classroom setup	(Kazeminia et al., 2022)
Theme 2: Lack of teachers to teach in flipped classroom model	
Shortage of trained flipped-classroom instructors	(Kazeminia et al., 2022)
Theme 3: Lack of ICT infrastructure	
Internet connectivity problems	(Cortez et al., 2023)
Outdated or defective ICT equipment	(Baig & Yadegaridehkordi, 2023)
Insufficient ICT facilities	(M. Aidoo et al., 2022)
Limited access to educational technologies	(V. Aidoo et al., 2022)

Cost of flipped classroom instruction

Han (2022) and Kazeminia et al. (2022) discussed the financial barriers that constrain teachers' capacity to fully implement the flipped classroom model, where the economic burden of transitioning to technology-driven instruction places disproportionate pressure on educators operating within resource-limited institutional environments.

Lack of teachers to teach in flipped classroom model

The study by Kazeminia et al. (2022) mentioned that flipped classroom teaching is quite expensive, which is needed to access to technology and physical classroom set up, and this leads to resistance from staff involved or even students.

Lack of ICT infrastructure

Studies of have mentioned the lack of ICT infrastructure as one of the challenges that the flipped classroom instructional model faces on its proper adoption and realisation in higher academic institutions (M. Aidoo et al., 2022; V. Aidoo et al., 2022; Baig & Yadegaridehkordi, 2023; Cortez et al., 2023).

Figure 2 presents a taxonomy of the challenges identified in the literature, categorised across three dimensions: student-related, teacher-related, and educational challenges in the pre-class phase of flipped classrooms.

Figure 2. A taxonomy of the engagement challenges in the pre-class phase of flipped classrooms

Discussion

This study presented a systematic literature review on student engagement challenges in the pre-class phase of flipped classrooms. Inspired by the foundational work of Rasheed et al. (2020), which explored challenges in the online component of blended learning, this study shifted focus to the flipped classroom model – a pedagogical strategy that has seen exponential growth in the past decade. As higher education institutions increasingly adopt flipped classrooms for their capacity to foster student-centred, active learning, it becomes imperative to examine the mechanisms supporting student engagement, particularly in the pre-class phase where autonomous learning is paramount.

Apart from the challenges students experience in learning with video, RQ1 also revealed other persistent challenges in emotional difficulties and the lack of peer collaboration, both of which significantly hinder student engagement in the pre-class phase. Interestingly, our findings indicate that students generally do not struggle with the usability or functionality of technology; rather, their main concern lies in equitable access to digital tools – a manifestation of the digital divide. This underscores the need for personalised, inclusive learning systems that cater to diverse learner backgrounds and technological contexts. A critical insight from this study highlights a glaring omission in the flipped classroom literature: the absence of a structured framework for fostering collaboration during the pre-class stage. Despite extensive evidence that collaborative learning improves knowledge construction, self-regulation and motivation (Rasheed et al., 2021), the flipped classroom model lacks formalised strategies for peer interaction before class. This gap represents a missed opportunity, particularly in addressing barriers to engagement like procrastination and motivational decline. While educational research has proposed several peer learning strategies, the flipped classroom community has yet to adopt a comprehensive, scalable model to integrate these practices. As a result, there is an urgent need for evidence-based frameworks that institutionalise collaborative learning in the pre-class context.

Another important finding is that studies have shown video production quality in flipped classrooms is often substandard and insufficient to effectively engage students during the pre-class phase. Key video production decisions that influence student engagement have frequently been overlooked, which has negatively impacted how students interact with pre-class video materials. It would be valuable for research to further explore the relationship between video timing, learning outcomes and procrastination behaviours in the context of pre-class activities.

RQ2 addressed challenges associated with the production of pre-class instructional videos – a core element of the flipped model. Evidence has shown that instructors often face significant burdens in terms of time, effort and cost when creating high-quality video content. This raises critical institutional questions: Are universities failing to support educators with adequate funding and technical resources? Or are instructors themselves hesitant to invest effort due to a lack of training or incentives? The findings suggest that insufficient institutional commitment – manifested in limited infrastructure, weak financial support and the absence of structured professional development – may be at the root of these issues.

RQ3 expanded on the systemic institutional barriers to successful flipped classroom implementation. Three interrelated challenges underscore a broader institutional failure to prioritise flipped learning. Despite its pedagogical benefits, flipped classrooms are often not treated as strategic investments by universities and the broader higher educational institutions. The assumption that existing infrastructure and self-taught educators are sufficient has proven inadequate. This study clearly shows that student and teacher disengagement is not simply a pedagogical issue, but a consequence of institutional neglect. If universities wish to reap the benefits of flipped classrooms, they must assume greater responsibility in ensuring the necessary financial, technical and emotional support for both instructors and learners. Future research should explore how student engagement can be enhanced by integrating the relatedness construct with personalised learning approaches, particularly through the incorporation of learners' cultural dispositions in pre-class video production.

Another important direction for future research is the role of epistemological beliefs in pre-class learning and the use of technology and video, as these beliefs shape how students perceive knowledge and learning, with research showing strong links to motivation, self-efficacy and academic achievement (Lee et al., 2022; Schommer, 1990).

Future practice and policy directions informed by the review findings

For flipped classrooms to achieve their full potential, strong institutional policies and practices are essential. Large-scale adoption of technology-enhanced learning requires strategic leadership, clear governance, continuous professional development and sustained technological support (Hill & Smith, 2023), as such models do not emerge organically but depend on deliberate institutional strategies.

Future research and policy should prioritise student-centred approaches that address engagement challenges in the pre-class phase. At the teacher level, institutions must recognise the increased workload and provide ongoing training in pedagogy, technology and instructional design, particularly for video-based learning.

At the institutional level, policies should address constraints such as staffing and cost through shared resources, open educational practices, and collaboration. While artificial intelligence-supported content development and learning analytics can improve scalability, their use must be guided by ethical frameworks ensuring data privacy and transparency.

Limitations

This review study is limited by its use of a selective search strategy and methodology, focusing exclusively on high-impact journals. As a result, the inclusion of conference papers or other sources – such as articles indexed in Google Scholar or databases that are not classified as high-impact – might have led to slightly different findings. Additionally, this study is restricted to literature specifically related to flipped classrooms. Had we expanded the scope to include broader areas such as e-learning or blended learning, the perceptions and challenges related to student engagement might have slightly differed.

Conclusion

This systematic literature review reveals three interdependent domains of concern: student-related barriers, teacher-centred constraints and institutional shortcomings in technological integration. This study presents a taxonomy of pre-class engagement challenges from students, teachers and educational institutions perspectives. While flipped classrooms offer immense potential for transforming learning into a more autonomous, student-centred process, their success is contingent upon robust emotional, pedagogical, and technological scaffolding – areas where many current implementations fall short.

Despite the increasing availability of educational technologies, the flipped classroom model has yet to fully capitalise on gamification and emerging technologies like artificial intelligence and machine learning to enhance pre-class engagement. Our findings underscore a lack of innovation in leveraging these tools to create adaptive, responsive, and emotionally intelligent learning environments. Moreover, institutional communication gaps and underinvestment in targeted ICT infrastructure remain core issues. Teachers often operate without the necessary training, tools or collaborative frameworks needed to design engaging pre-class experiences. This misalignment between pedagogical vision and institutional execution significantly limits the scalability and sustainability of the flipped classroom model.

Author contributions

Zahra Nasser Alsiyabi: Conceptualisation, Investigation, Writing – original draft, Writing – review and editing; **Amirrudin Kamsin:** Data curation, Investigation, Formal analysis, Writing – review and editing; **Nor Aniza Abdullah:** Writing – review and editing; **Rasheed Abubakar Rasheed:** Conceptualisation, Writing – review and editing.

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