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Enhancing student engagement through flipped classroom approach: An action-research study

Mejorar la participación de los estudiantes a través del enfoque de aula invertida: Un estudio de investigación-acción

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ABSTRACT

This action-research examines a four-week flipped-classroom intervention in an Intermediate Accounting course at a Bangladeshi government women's college. 62 of 73 enrolled second-year Bachelor of Business Administration (BBA) students participated in the intervention; participation and formative data were collected across four weeks using short pre-class videos (YouTube), a closed Facebook group, and weekly Google-Form formative quizzes. Engagement indicators such as average video views, class attendance, and mean quiz scores increased during the intervention. A paired-samples t-test indicated a statistically significant within-student improvement, $t(27) = 8.31$, $p < .001$, Cohen's $d = 1.57$, with a 95% confidence interval for the mean difference of [8.53, 14.12]. A Wilcoxon signed-rank test produced consistent results. Because the study employed a practitioner-led action-research design without a control group, the results should be interpreted as exploratory evidence associated with the flipped intervention rather than causal proof of

effectiveness. Reflections from students indicate that pre-class preparation, peer collaboration, and flexible access to educational materials contributed to increased participation. The study shows how low-cost digital platforms can facilitate blended learning methods in higher education environments with limited resources. However, further research using comparative or longitudinal methods is needed for a more comprehensive assessment of learning outcomes and sustainability.

Keywords: Flipped classroom, student engagement, accounting education, blended learning, Bangladesh.

RESUMEN

Esta investigación-acción examina una intervención de aula invertida de cuatro semanas en un curso de Contabilidad Intermedia en una universidad para mujeres del gobierno de Bangladesh. 62 de los 73 estudiantes de segundo año de Licenciatura en Administración de Empresas (BBA) matriculados participaron en la intervención; la participación y los datos formativos se recopilaron durante cuatro semanas utilizando videos cortos antes de clase (YouTube), un grupo cerrado de Facebook y cuestionarios formativos semanales de Google Forms. Los indicadores de participación, como las vistas promedio de videos, la asistencia a clase y las puntuaciones medias de los cuestionarios, aumentaron durante la intervención. Una prueba t para muestras emparejadas indicó una mejora estadísticamente significativa dentro de los estudiantes, $t(27) = 8.31$, $p < .001$, d de Cohen = 1.57, con un intervalo de confianza del 95% para la diferencia de medias de [8.53, 14.12]. Una prueba de rango con signo de Wilcoxon produjo resultados consistentes. Debido a que el estudio empleó un diseño de investigación-acción dirigido por profesionales sin grupo de control, los resultados deben interpretarse como evidencia exploratoria asociada con la intervención invertida en lugar de como prueba causal de efectividad. Las reflexiones de los estudiantes indican que la preparación previa a la clase, la colaboración entre compañeros y el acceso flexible a los materiales educativos contribuyeron a una mayor participación. El estudio muestra cómo las plataformas digitales de bajo costo pueden facilitar los métodos de aprendizaje combinado en entornos de educación superior con recursos limitados. Sin embargo, se necesita más investigación utilizando métodos comparativos o longitudinales para una evaluación más completa de los resultados de aprendizaje y la sostenibilidad.

Palabras clave: *Aula invertida, participación estudiantil, educación contable, aprendizaje semipresencial, Bangladesh.*

INTRODUCTION

Higher-education instruction in Bangladeshi public colleges has traditionally relied on lecture-centred approaches, which efficiently transmit content but frequently limit students' opportunities for active learning and the development of higher-order cognitive skills required in analytical disciplines such as accounting (Fredricks, Blumenfeld, & Paris, 2004). During the COVID-19 pandemic, educators rapidly adopted a variety of online and blended approaches, increasing interest in pedagogies that redistribute content delivery outside the classroom and reserve in-class time for application and collaborative activities (Divjak et al., 2022). The flipped-classroom or inverted learning approach is one of the notable examples among these approaches. In this model, students independently learn the basic concepts of the class topics through video or text material before coming to the classroom, and the classroom time is spent in active practice, problem solving and collaborative activities. This reorientation in structure has gained increasing importance in research as an effective means of increasing student participation and deepening conceptual understanding (Bishop & Verleger, 2013; Akçayır & Akçayır, 2018).

Although meta-analyses and systematic reviews indicate the positive impact of the flipped approach on increased participation and learning outcomes in many areas (Hew & Lo, 2018; Strelan, Osborn, & Palmer, 2020), the evidence-based application of this approach in resource-constrained higher education contexts, particularly in public colleges in South Asia, is still relatively low. Studies conducted in these contexts often show some real limitations - such as poor internet connectivity, device constraints, and limited understanding by teachers of blended pedagogies - that directly affect implementation-related decisions (Rasheed, Kamsin, & Abdullah, 2019). Consequently, the present study documents and evaluates a short-term flipped-classroom implementation in Moulvibazar Government Women's College in Bangladesh, targeting the Intermediate Accounting course for second-year BBA students. Because the study was conducted in a women's college, the institutional context may also shape patterns of classroom participation and peer interaction. At the same time, students in such contexts may experience structural constraints such as family responsibilities or limited access to digital devices. Recognizing this contextual dimension is important for interpreting the findings and considering their generalizability to other institutional environments.

The current research addressed two primary questions:

1. During the implementation, how did the flipped-classroom model affect student involvement (both online and in class)?
2. What changes in formative assessment performance accompanied the intervention?

The study used a mixed-methods action-research design to provide both descriptive quantitative evidence and qualitative insights from student reflections. The aim was pragmatic: to produce contextually valid evidence that can inform classroom practice, local professional development, and incremental institutional adoption.

LITERATURE REVIEW

The flipped-classroom approach: conceptual grounding and empirical syntheses

The flipped approach is a mixed learning method that emphasises active participation and learning among students, allowing instructors to address different levels of ability, student challenges, and diverse learning preferences in real classroom settings. The flipped-classroom approach reverses elements of the traditional instructional sequence by assigning information transmission tasks (e.g., short lectures, readings) as pre-class work and devoting in-class time to active tasks—problem solving, discussion, and formative feedback (Bishop & Verleger, 2013). This approach is derived from Vygotsky's (1978) constructivist and social learning theories where the role of prior knowledge and social interaction in constructing understanding is emphasized. It is a learner-centered instructional strategy wherein learners get access to essential reading materials or lecture videos prior to the class, and then class time is utilized for discussion, problem-solving, or other types of active learning that can assist the students to realize and integrate this new knowledge. Reviews and meta-analyses conducted across disciplines indicate that flipped instruction frequently enhances student engagement and can produce small-to-moderate increase in learning outcomes, although effect sizes vary and depend on implementation quality and assessment types (Akçayır & Akçayır, 2018; Hew & Lo, 2018; Strelan et al., 2020).

Engagement, motivation and assessment in flipped settings

Engagement is a multifaceted construct that includes behavioural, emotional, and cognitive elements (Fredricks et al., 2004). Flipped-classroom designs have been suggested to assist each dimension: pre-class resources enable students to progress at their own pace, in-class activities provide practice and feedback, and a learner-centred setting may enhance emotional involvement and motivation (Lo & Hew, 2017). A flipped classroom uses several kinds of content and materials to make the lesson work. Teachers or instructors often make video lectures to teach the content,

but online group discussions and written materials can also be used. The components of the classroom vary based on the degree of learning expectations, student involvement, and autonomy (Bergmann & Sams, 2012). Bull, Fester, & Kjellerstrom (2012) contend that the learning context and objectives of a flipped classroom determine its most beneficial features, offering educators many pedagogical strategies to instruct students. A flipped classroom is characterized by the systematic use of interactive technologies (Strayer, 2012). EdPuzzle, Screencastify, Verso, NOVA, and Ted-Ed are just a few examples of modern educational technology that are making the flipped classroom technique the best method for both students and teachers to learn. This pedagogical method, based on Bloom's revised taxonomy (Anderson & Krathwohl, 2001), allows students to independently engage in foundational cognitive tasks (knowledge acquisition) outside of the classroom. Subsequently, in class, they engage in more complex cognitive tasks (application, analysis, evaluation, creativity) with assistance from the teacher and peers.

Students experiencing difficulties attending regular classes get significant advantages from the flipped classroom model. These students may still get the fundamental knowledge required for the courses using online resources. The flipped classroom model maximizes instructional time, improves interactive learning experiences for students (Gannod, Burge, & Helmick, 2008), and cultivates personal connections between students and teachers (Lage et al., 2000). In a flipped classroom, students spend most of their time doing hands-on activities instead of listening to lectures. This approach has many benefits, such as more time for interaction and clarification of materials, more chances to explore ideas in depth, and more time to meet additional learning goals or conduct exercises (Boucher et al., 2013). Research shows that flipped courses lead to more attendance, involvement, and satisfaction. There is also consistent evidence that formative low-stakes quizzes and in-class assessments make these benefits even better (Hew & Lo, 2018).

A flipped classroom approach has several limitations too. Flipped classroom approach requires digital devices and internet connection for students, but, due to the dissimilar socio-economic background all families have no access to essential devices at home and thus equal participation is not possible for all students. Moreover, the students who are not in progressive stage may perform poorly in home atmosphere where learning is self-directed, and they might fall rapidly behind their peers. Many opponents claim that flipped models may lead to expanded computer time where youths even now employ huge time before computer screens. Strayer (2012) argued that because of increased responsibilities, flipped classroom might be less beneficial for slow learners. Instructors also might face difficulties with flipped models. Preparing high-quality videos necessitates tutors to pay more time and energy beyond the usual teaching responsibility.

Flipped learning in accounting education

The flipped-classroom model has emerged as a popular pedagogical innovation in higher education in recent decades, particularly in contexts requiring active student engagement and the application of advanced cognitive skills. In accounting education, where conceptual understanding and methodical practice is crucial, a flipped design may significantly enhance student preparedness and participation. Ling, Li, & Deni (2019) showed in their study that pre-class videos and materials of financial accounting make students more interested and better prepared for assessments. Some other research shows that the flipped model works better when the content is good, the classroom activities are interesting, and the education before and after class is the same (Divjak et al., 2022; Li & Li, 2022). Nonetheless, employing suitable design, accessible platforms (such as YouTube and Google Forms), and strategically structured classroom activities can make flipped-classroom accounting a feasible and evidence-based method for increasing student engagement and developing conceptual skills.

Flipped learning in low-resource settings and gendered contexts

Research in developing countries shows that flipped classrooms are notably successful only when they are implemented using low-cost and easily available platforms such as YouTube, Facebook, WhatsApp, Google Forms, etc., and the teacher is dedicated to preparing the students for self-regulated learning (Divjak et al., 2022; Rasheed et al., 2019). Specialized education institutions, such as girls' schools and colleges or women's universities, have both the opportunities and the problems necessary to implement flipped classrooms. Inherent peer networks among female students in women's education institutions enhance collaborative learning, but societal roles and restrictions may limit extra-curricular engagement for some students.

Recent discussions in the sociology of higher education also emphasise that student engagement and attendance should be understood within broader institutional and motivational contexts rather than purely as individual learning behaviours. For example, Águila-Díaz, Quesada-Cubo, & Valdivia-Alonso (2025) analyses university absenteeism as a structural phenomenon shaped by motivation, institutional culture, and pedagogical design. From this perspective, teaching innovations such as flipped classrooms may contribute not only to instructional efficiency but also to addressing wider challenges of student disengagement and participation in higher education.

Gaps addressed by the present study

Although reviews and meta-analyses generally report favourable outcomes for flipped instruction, there is a need for studies that (a) document pragmatic implementation strategies using popular and readily available platforms, (b) focus on public higher-education institutions in South Asia, and (c) integrate formative performance metrics with student reflections. The present study contributes to this gap by reporting a one-month implementation in a Bangladeshi government women's college, using a readily replicable set of digital tools and an emphasis on formative assessment.

METHODOLOGY

Research design and rationale

The study employed an action-research design appropriate for practitioner-led curriculum innovations (Reason & Bradbury, 2008). The instructor implemented the flipped approach, collected formative data during the intervention, and analysed outcomes to improve the recurrent practice. This design focuses ecological validity and immediate application for classroom improvement while integrating both quantitative and qualitative evidence.

Context and participants

The study took place at Moulvibazar Government Women's College in Bangladesh during the 2021–22 session. A total of 73 female students enrolled in the second-year BBA Intermediate Accounting course. A previous study (Awal, 2022) found chronic and large absenteeism among the students at this college. Despite making significant efforts to reach all students, of the 73 enrolled students, 62 participated in the intervention. The researcher asked the 62 students to subscribe to the private YouTube channel and included them all in the private Facebook group. The researcher created this private YouTube channel and Facebook group specifically for research purposes. Prior to the intervention, the course was delivered mainly through lectures, with limited active participation during class time.

Intervention: instructional design and tools

Over a one-month period (four weeks), the instructor implemented the following protocol:

1. Pre-class materials: For each week, the instructor uploaded a self-prepared or a collected short video lecture (approximately 8–10 minutes) and a one-page study guide to a private

YouTube channel; and accompanying documents and prompts were shared in a closed Facebook group created for the class. Students were asked to watch the uploaded video and complete brief guiding questions before attending the scheduled class.

2. In-class activities: In-class activities focused on problem-solving, pair works, and instructor-facilitated feedback. The instructor used a rotating set of small-group problems linked to the pre-class content.
3. Post-classroom formative assessment: At the end of the class, low-stakes quizzes (e.g., stress-free short-range quizzes that do not affect grades) were administered through Google Form to strengthen the students' ideas and give immediate feedback. To ensure consistency across the intervention period, the quizzes were designed directly from the Intermediate Accounting syllabus topics covered each week. Each quiz consisted of short conceptual questions and procedural accounting activities such as journal entries and ledger adjustments, which required application-level cognitive skills matched with Bloom's revised taxonomy (Anderson & Krathwohl, 2001). Despite the quizzes were not standardized, attempts were made to ensure uniform cognitive load and topic covering over the weeks. These examinations were formative and low-stakes, primarily aiming to provide students with feedback on their comprehension rather than functioning as summative evaluations.
4. Communication and scaffolding: The Facebook group was used as the main platform for all announcements, discussions, and student interactions. The teacher posted instructional prompts regularly and encouraged students to ask questions so that the students could prepare before coming to the classroom.

This intervention was consciously designed using readily available and cost-effective digital platforms, so that the model is easily replicable and applicable in resource-constrained contexts.

Data Collection

Four types of data were collected in this study:

- Participation logs: Participation logs are records of video views, comments, reactions, and classroom attendance in a Facebook group.
- Formative assessment results: The number of Google Form quizzes taken per week (a total of four quizzes).
- Classroom observation note: After each class, the teacher recorded constructive observations about the students' interactions, the type of questions asked, and the type of teamwork.
- Student reflections: At the end of the month, students completed an anonymous open-ended Google Form prompting short comments on what helped their learning and challenges experienced.

Administrative permission to conduct the study was obtained from college authority. No written informed consent was obtained from the students; nonetheless, it was clarified that participation was entirely optional, and no individual was subject to penalties for nonparticipation. Students were informed that anonymized participation records and quiz results could be used for educational research purposes. Participation in the reflection survey was voluntary, and responses were collected anonymously through Google Forms. Because the instructor also served as the researcher, the quizzes were designed as low-stakes formative exercises that did not affect course grades in order to minimize any perceived pressure on students.

Data analysis

Quantitative indicators (participation counts, average formative scores) were summarised descriptively: means, percentage changes, and completion rates. Where pre- and post-measurements were available in the intervention period data (e.g. comparison of 1st and 4th week

quiz results), paired-samples comparisons were performed; however, the study design did not include any randomized control group or previous lecture-based quiz data.

Qualitative responses from the reflection form were analysed using an inductive thematic approach. Responses were coded line-by-line, codes were grouped into broader themes, and illustrative anonymised quotations were selected to exemplify each theme.

Trustworthiness and limitations of methods

To enhance trustworthiness, the instructor used data triangulation (assessment records, logs, and reflections).

There are some limitations to this research. First, it is a one-month long short-term intervention, which did not provide an opportunity to verify the retention of learning in the long run. Secondly, there was no control group, so it is not possible to single out flipped classroom as the whole reason for improvement. However, within-subject analysis (paired t-test) indicates real improvement in student learning. Third, the sample size (n = 28) is relatively small, which limits the generalization of the results. Fourth, for some students, internet and device restrictions may hinder participation.

RESULTS

Online engagement

Across the four-week intervention, online participation through the private Facebook group was high and gradually improved. The average weekly video view rate per student increased from 67.7% in Week 1 to 83.9% in Week 4 (N = 62), indicating strong compliance with pre-class preparation. Average weekly comment participation rose from 40.3% to 61.3%, reflecting greater willingness to interact with peers and the instructor online. A total of 54 student-initiated discussion threads were recorded across the month, in addition to 109 instructor posts and replies.

In-class engagement

Average class attendance during the intervention period was 59.27%, compared with 46.77% during the preceding lecture-based month—a 12.5 percentage point improvement. In addition, some of the enrolled students participated in online pre-class activities though they did not attend the in-class activities. Observation notes documented that approximately two-thirds of attended students actively participated in small-group problem solving by the second week, compared with fewer than one-third before the intervention. Students more frequently volunteered answers and engaged in peer explanations during accounting journal exercises.

Qualitative observation summary

Instructors observed that there were more spontaneous questions and corrections of mistakes during pair-based tasks. Students appeared more comfortable discussing procedural steps and comparing journal entries across groups. These behavioural shifts indicated heightened cognitive and social engagement.

Table 1. Participation metrics

WEEK	AVG. VIDEO VIEWS (% PER STUDENT, N=62)	COMMENT THREADS (COUNT)	STUDENTS ATTENDED AND ATTENDANCE RATE (%)	QUIZ COMPLETION RATE AMONG ATTENDED STUDENTS (%)
1	67.7	09	35 (56.45)	80
2	72.6	13	37 (59.67)	81.08
3	77.4	15	36 (58.06)	83.33
4	83.9	17	39 (62.9)	89.74

Formative-assessment performance

Formative quizzes conducted weekly provided quantitative evidence of learning progress. Mean quiz performance improved steadily over the month, rising from 64.86% (SD = 4.866) in Week 1 to 76.57% (SD = 5.387) in Week 4. Completion rates also increased from 80% to 89.74% (see Table 1), suggesting growing motivation and engagement.

Table 2. Formative quiz performance

QUIZ	N COMPLETED	MINIMUM	MAXIMUM	MEAN (%)	SD	NOTES
QUIZ 1 (WEEK 1)	28	56	74	64.86	4.87	Baseline quiz after first flipped session
QUIZ 2 (WEEK 2)	30	57	82	68.53	5.970	Gradual improvement in conceptual tasks
QUIZ 3 (WEEK 3)	30	61	80	72.87	4.547	Stronger procedural accuracy
QUIZ 4 (WEEK 4)	35	65	91	76.57	5.387	Consolidated mastery evident

During the analysis of formative assessment results, week-wise differences in participation were observed to conduct a paired-sample t-test. In the first week, 35 students attended the class, but 28 of them completed the quiz. In the fourth week, the number of attendees increased to 39 and the number of quiz participants increased to 35. However, statistically paired-samples t-test can only be performed on the basis of two-time outcomes of the same students. Therefore, the analysis includes data from all 28 students who participated in both the Week 1 and Week 4 quizzes, so that each pair of data represents the same participant. This method is statistically appropriate, because it reflects the actual change in student learning (within-subject change) and reduces the impact of sample-based variation. The data of other students (who took the quiz only in Week 4) is included in the descriptive analysis only, but their results are not used in the paired analysis.

The paired-sample t-test results revealed a statistically significant improvement from Mean = 64.86% (SD = 4.87) to Mean = 76.18% (SD = 5.29), $t(27) = 8.31$, $p < .001$, with a very large effect size (*Cohen's d* = 1.57). *Cohen's d* is considered as a large effect size when *Cohen's d* >0.8 (Cohen, 1988). The mean difference of 11.32 percentage points was accompanied by a 95% confidence interval of [8.53, 14.12]. A Wilcoxon signed-rank test yielded consistent results; Z = 10.73, p=.000005 (p < .001), confirming that the improvement was both statistically robust and educationally meaningful.

It is worth noting that students who completed the test in the first and fourth weeks may represent a subgroup of the class that is consistently more engaged. Students who regularly attended less or were less active in online activities may be under-represented in the comparative analysis. Hence, the observed improvements in learning should be interpreted with caution and may not fully represent the performance patterns of all students.

Thematic findings from student reflections

A total of 38 valid reflection responses were submitted via Google Form (97.44% of the total participants attended in 4th week class, number of attended students was 39). Thematic analysis revealed three major themes consistent with enhanced engagement and self-efficacy:

Theme 1 — Preparedness and confidence

Most students said that seeing short videos before class helped them understand the contents clearly and become ready.

One student said, "I already knew what the topic was about when I came to class, so I felt more confident about how to solve examples." Another student said that the materials they read before class help them prepare for the real class and let them focus more on the activities that happen in class.

Theme 2 - Collaborative learning increased clarity

Most of the students reported that participating in group discussions and joint activities within the class helped them to clear their confusion and clarify their ideas. By sharing the problem-solving process with classmates, they were able to recognize their mistakes and learn to think differently. One of the participants said, "Teamwork helped me understand where I was going wrong and how others were solving it in a different way."

Another student said, "It is very easy to understand a problem when I discuss it with my classmates."

Another said: "I didn't know where I was going to get stuck when I was studying alone, but when I was working in a group, I could figure out the problem."

However, one student stated that the new method (flipped method) is more time-consuming and creates inequality among the students. She added, "Many of us do not have our own device and have limited time to spend both inside and outside the classes."

Theme 3 - Flexibility and Accessibility

Students reported that watching and rewatching videos at their own convenience on mobile devices made learning easier and more personalized. Some of the students prepared for the quiz by re-watching the video using the Internet at a low cost at night.

One student has given her feedback like, "I could have watched the video again if the internet speed was better at night; it would have been better reviewed before the quiz."

Another student added that "I was able to learn the difficult parts at my own pace.

"One more student replied that "I could read from my phone at any time – it made my studies a lot easier, especially when I had to work at home."

Some minor challenges were exposed, like poor internet connections (15% of the respondents) and not having a gadget (7.69%) to use. These challenges coincide with the recent research findings on the digital equity challenge in low-resource contexts.

DISCUSSION

Interpretation of the findings

In this study, the application of the four-week-long Flipped Classroom approach resulted in significant improvements in student participation, readiness, and mean quiz scores. The average score of the students in the preliminary (Week 1) quiz was 64.86% (SD = 4.87) which increased to 76.18% (SD = 5.29) in the fourth (Week 4) week. That is, an average improvement of 11.32

percentage points has been observed. This difference is statistically significant ($t(27) = 8.31$, $p < .001$), while the effect (Cohen's $d = 1.57$) is considered large. According to the 95% confidence interval, the actual average improvement range is between 8.53 and 14.12 percent. The Wilcoxon signed-rank test ($T = 373.5$, $p < .001$) confirmed the same result.

The magnitude of the observed effect size (Cohen's $d = 1.57$) is relatively large. Several factors may partially contribute to this large magnitude. First, the within-subject design measures improvement among the same students across a short time period. Second, the quizzes were formative assessments closely aligned with weekly learning activities. Third, the paired analysis included students who completed both quizzes, who may represent a more active participant group of the class. For these reasons, the effect size should be interpreted cautiously and not as a definitive estimate of the broader pedagogical impact of flipped instruction.

These statistical results suggest that the flipped classroom intervention was associated with improvements in students' formative performance during the study period. Supporting Hew and Lo (2018), the present research has shown that quizzes and real-time feedback are two important learning aids. Engaging in online discussions and replay behaviour indicates that students have taken advantages of asynchronous features to self-regulate their study speed - which is an important component for flipped models to be effective (Lo & Hew, 2017). Similarly, Strelan, Osborn and Palmer (2020) show from the analysis of multiple studies that this method consistently has a positive effect on the academic performance of students.

The thematic findings of this study about peer support and self-confidence in flipped classrooms are consistent with those from other relevant studies. For example, according to Divjak et al. (2022), flipped learning can enhance students' social and emotional development alongside their academic progress, which is consistent with the current study findings. Reflections from students suggest that pre-class videos in flipped design and online discussions have made them more confident about in-class activities. The combination of pre-class video and collaborative classroom tasks has created a consistent and active learning environment. This is consistent with Vygotsky's (1978) theory of social constructivism, where learning is a social process and knowledge is formed through mutual cooperation and reflection.

Implementation lessons for low-resource contexts

This research has shown that it is possible to successfully implement flipped classrooms even with limited technical and financial resources. No paid learning management system was used; instead, free platforms such as Facebook, YouTube and Google Forms are used. 67.7% of students watched the uploaded videos in Week 1, and by Week 4, that percentage had gone up to 83.9%. The percentage of students who finished the quiz went up from 80% to 89.74%. The effectiveness of this intervention depended on four design concepts that functioned together. These design concepts are platform pragmatism, scaffolding for accountability, participatory facilitation, and contextual sensitivity.

Platform pragmatism: Effective use of ubiquitous, low-cost tools

Rather than relying on a commercial LMS, this intervention used a private Facebook group and YouTube channel—platforms well known to almost all students. This choice reduced the cognitive load associated with the new technology and avoided the institutional IT problems. Participation data prove the validity of this approach: video viewing rates above 90% and the emergence of 54 peer-initiated discussions indicate that common social platforms can serve as effective academic environments if managed purposefully.

From the implementation perspective, teachers who are in a similar situation should focus on accessibility by selecting tools that require minimum data and that can be on mobile devices which allow asynchronous access. This viewpoint is similar to the views of Rasheed et al. (2019), who argue that technological familiarity is often a stronger predictor of participation than platform capability in low-resource environments.

Scaffolding for accountability and continuity of learning

The current study demonstrates a significant behavioural improvement that is a consistent rise in the quizz completion rate (from 80% to 89.74%). Deliberate scaffolding led to this improvement: classroom activities were closely linked to the pre-class material, and each pre-class film was followed by a quiz. Students were hence clearly motivated to prepare, which supports the self-regulated learning pattern.

Participatory support and peer support

The observations revealed a qualitative transformation in classroom dynamics: the proportion of students actively participating in problem solving increased significantly in just four weeks. This behavioral change is consistent with the "collaborative transparency" theme of student reflection, in which students reported gaining deeper conceptual understanding through pair-to-pair discussions.

These results demonstrate that it is teacher support, not technology, that drives flipped learning success. The instructor's active management of online forums, timely feedback in Facebook discussions, and structured classroom peer work have created an integrated feedback environment. Therefore, the training program for tertiary-level teachers should include modules on digital facilitation skills, with emphasis on conversational management, constructive feedback techniques, and methods for maintaining participatory equanimity during classroom teamwork.

Relevant sensitivities and gender considerations

This intervention took place at a women's college, where many students balance academic responsibilities as well as family responsibilities. This research developed a theme named 'flexibility and accessibility' theme which claims that asynchronous design of flipped method reduces gender inequality by allowing students to study on mobile devices at night or while out of work. This study also explores that about 13% of respondents experienced poor Internet connection, and 8% of the participants have limited device access, indicating the presence of structural barriers. To minimize, colleges may consider providing hybrid resource packages to help students who have irregular internet connections. These packages may include components such as downloadable PDFs, low-bandwidth audio summaries, or offline video transfers via memory cards.

Institutional and policy implications

At the institutional level, the study highlights the need to recognise the labour of the teacher. Creating short, high-quality videos and conducting online discussions has been estimated to require an additional 6–8 hours per week. Without institutional incentives—such as workload credits, digital-content repositories, or micro-grants, such efforts may not be sustainable.

In principle, the findings may offer preliminary insights for institutional pilot initiatives. Professional-development institutions such as NAEM (National Academy of Educational Management) should integrate a dedicated "Digital Teaching Methodology and Evaluation" module in Foundation Training and in other teacher training programs so that future teachers can acquire both technical and pedagogical skills for flipped learning. However, broader national policy initiatives should be informed by additional comparative and longitudinal research.

Summary: Towards sustainable flipped learning in Bangladesh

The study presents both quantitative and qualitative evidence, showing that small-scale, low-cost digital transformation driven by well-planned design and reflective practice can also bring high educational benefits. Divjak et al. (2022) claimed that significant statistical gains are possible even in the presence of infrastructural constraints. This ability to deliver quality instruction even when resources are limited is termed as "pedagogical resilience." To ensure sustainable progress, these initiatives should not be confined to a single classroom experiment; rather, they must be implemented broadly as a part of institutional strategy. These initiatives may:

1. Provide a shared repository of Bengali-language instructional videos for high-enrolment subjects;
2. Formalize peer-mentoring networks where digitally proficient instructors support

newcomers; and

3. Collects longitudinal data to track learning outcomes.

In summary, the implementation experience of this study demonstrates that effective inverted instruction in under-resourced public colleges is dependent less on advanced infrastructure and more on human design intelligence, i.e., affordable tools, motivational scaffolds, and careful alignment of socio-economic realities to authentic participation.

Directions for future research

The findings of this study can be examined more deeply through future research in several ways. First, long-term studies across multiple semesters can help show how well students retain what they learn and how lasting the effects of the flipped classroom are. Second, comparing flipped classes with traditional lecture-based teaching can give a clearer idea of the real impact of each method. Finally, future work can look at how the digital divide—differences in access to technology and students' socio-economic backgrounds—shapes their ability to take part in learning activities. Such futuristic research will help create sustainable and inclusive models of implementing flipped classrooms at the low resource contexts in Bangladesh.

CONCLUSIONS AND IMPLICATIONS

According to the findings of the study, the flipped classroom approach - which includes watching short videos before class, planned activities in the classroom, and lesson designs based on formative assessments - has been shown to be effective in increasing student engagement and performance on formative assessments. The use of this method offers a practical approach to enhancing active learning in environments where formal learning management systems (LMS) and institutional support are available in insufficient quantities.

Implications for practice and policy

For instructors: start with a short pilot project (a module), create short videos focused on common mistakes, use low-key formative quizzes to encourage discipline, and structure classroom activities to provide peer-supported problem solving.

For institutions: Provide professional development training on digital learning methods, recognize instructor time for content creation, and explore possibilities for early infrastructure improvements (campus Wi-Fi, download hub etc.).

For policy makers: support small-scale micro-grants that give instructors the opportunity to create contextually appropriate blended learning material; integrate blended-pedagogy training into teacher development curricula.

The study provides an evidence-based, replicable framework for implementing the inverted method in a similar Bangladeshi context. Although the results are promising, the methodological limitations of the study indicate the need for larger, comparative and long-term investigations to give substance to the initial achievements observed here.

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