Students' Performance and Perceptions of Flipped Classroom Approach in Business Mathematics

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Abstract

The Flipped Classroom is an innovative instructional approach increasingly adopted in higher education for promoting higher-order thinking and problem-solving. It combines individualized pre-class learning through online lecture videos with in-class collaborative activities guided by instructors. Despite its global adoption, this model remains underexplored in Nepalese higher education institutions (NHEIs). This case study examined the learning outcomes and student perceptions of the flipped approach over four weeks in a Business Mathematics class of 40 students at a Far Western University Campus. Data were collected through a test, a student survey, and a focus group discussion with six purposively selected students. Descriptive and qualitative analysis indicated improved student performance and positive perceptions. Students reported enhanced understanding, problem-solving skills, and development of digital and social competencies. They also considered the approach suitable for digital-era learners and expressed interest in applying it to other courses. Key factors identified for successful implementation included adequate digital infrastructure, skilled educators, motivated students, and clear, high-quality lecture videos. The study highlights the potential of the flipped model to improve teaching and learning in NHEIs and encourages university administrators and educators to adopt it for quality education. It also calls on scholars to explore the model further, addressing existing research gaps and ensuring broader, more generalizable findings through extended studies.

Keywords: flipped classroom approach, students, performance, perceptions, business mathematics

Introduction

Flipped classroom approach (FCA), characterized as an active, innovative, and technology-driven pedagogical method (Cevikbas & Kaiser, 2020; Patterson et al., 2018), has gained global traction across higher education as it effectively addresses students'

needs by enhancing their higher-order thinking and problem-solving abilities (Aljaraideh, 2019). This model facilitates preliminary learning via video lectures and supportive materials before attending class, and comprehensive learning through in-class interactive activities such as discussions, collaborative tasks, individual work, project work, and problem-solving under the teacher's guidance (Bergmann & Sams, 2012; Bishop & Verleger, 2013). In this regard, the Flipped Learning Network [FLN] (2014) defines the model as "a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter" (p. 1). The out-of-class and dynamic in-class learning activities of FCA significantly influence students' understanding, higher-level competencies, academic performance, and social skills by fostering their learning motivation, engagement, self-regulation and facilitating extra in-class time and feedback (Abeysekera & Dawson, 2015; Aljaraideh, 2019; Cheng et al., 2019; Lee & Choi, 2019; Muir, 2016). The FC model, characterized by its innovative use of technology and focus on learner engagement, seems to be more conducive to facilitating meaningful learning across various educational levels and subject areas (Algarni & Lortie-Forgues, 2023; Bergmann & Sams, 2012, 2015; Lee, 2023; Lopes & Soares, 2018), particularly in the field of mathematics, when compared to lecture-based approaches.

Concerning mathematics education via the flipped classroom (FC) strategy, Cevikbas and Kaiser (2020), Ford (2015), McBride (2015), and Wei et al. (2020) echoed that this method holds the potential to improve mathematics teaching and learning by facilitating active participation, interaction, feedback, and scaffolding for learners. Likewise, Lo et al. (2017) highlighted the significant impact of FC's in-person feedback, extra class time, and peer learning on mathematics learning, as compared to lecture methods. Moreover, Salami (2024), applying FCA in an Applied Mathematics course, found that students had positive perceptions and learning experiences regarding curiosity, engagement, and enlightenment, and suggests that the model is beneficial for maintaining interest and improving academic performance across all levels of mathematics education. Thus, many FC studies in mathematics have revealed significant pedagogical advantages over lecture methods as FCA facilitates flexible, self-directed, individualized, differentiated, and collaborative learning experiences (Abeysekera & Dawson, 2015;

Cheng et al., 2019; Lo et al., 2017; Park & Kim, 2022). In contrast, some FC studies have depicted low positive or no impact on student performance and perceptions compared to the conventional methods (e.g., Clark, 2015; Strayer, 2012) that might be due to the inappropriate designs, frameworks, implementation and evaluation strategies, course nature, including lack of digital access and skills, students' unfamiliarity with the model and unpreparedness (Fung et al., 2021; Kostaras, 2017). Thus, creating a proper flipped learning environment and adopting appropriate, context-based flipped pedagogical strategies can assure significant impact in mathematics education at all levels.

Drawing upon the above-mentioned FC's concept, pedagogical aspects and impacts, the researcher, as a mathematics educator at Far Western University (FWU), Nepal, finds the model an alternative, student-centric, and effective instructional strategy to be adopted in Nepalese higher education mathematics contexts, specifically in the Business Mathematics (BM) course at FWU. Business Mathematics is an applied mathematics course for first-semester students enrolled in the Bachelor of Business Administration (BBA) programme under the Management Faculty at FWU. The course aims to provide theoretical and practical knowledge of mathematical contents like algebra and equations, graphs, lines and inequalities, logic, sets and counting, functions and graphs, mathematics of finance and systems of linear equations and matrices; enabling them to understand and apply the basic mathematical tools in business decision-making, and enhancing their problem-solving ability in business era (Lial et al., 2015). As the majority of the enrolled students have a non-mathematical background, FCA can be more conducive to meaningful learning and achieving the course objectives than lecture methods. Additionally, my experience of employing the lecture method in the course is that it has constrained students' motivation, engagement, creativity, higher-order abilities, attitudes and performance. In this context, Acharya et al. (2022) and Luitel et al. (2024) stated that traditional lectures are ineffective for promoting meaningful mathematics learning and have suggested adopting alternative learner-centric pedagogical strategies to develop students' higher-order abilities and achieve better outcomes in mathematics. Moreover, Nepal's National Education Policy [NEP] (2019) has highlighted adopting technology-friendly alternative pedagogical methods to enhance education quality and foster students' 21st-century skills, which the FC model can meet well. However, in the NHEIs, the flipped approach, being a new emerging instructional format, seems less practiced and researched. There appears to be a notable lack of FC studies in mathematics

contexts, particularly in the BM course at FWU. Therefore, this study aims to explore students' performance and perceptions of FCA in the BM course at FWU. The study seeks to answer the following research questions.

1. What performance do the students show when applying the FC approach in the business mathematics course?
2. What are students' perceptions of the FC model in the business mathematics course?
3. How do students perceive the FC approach in the course?

This study can be crucial in encouraging the educators of business mathematics and other subjects to apply the FCA for quality learning. Likewise, it can inform higher education authorities, policymakers and curriculum designers to consider the FC model as an effective instructional strategy and create a proper FL environment in the institutions. Moreover, the study will motivate Nepali scholars to conduct further studies in this domain to fill the existing gap in the literature.

Literature Review

Flipped Classroom, an Emerging Pedagogical Approach

The flipped classroom approach (FCA) is an active teaching strategy that emerged in the 1990s, driven by technological advancements and educators' desires to improve academic quality (Ahmed, 2016). It represents a shift from traditional teaching methods to learner-centered approaches through the integration of technology.

Regarding the evolving practices of the FC model, in 1995, Backer initiated the approach in his graphic design course by providing online content notes, facilitating extended discussions, administering quizzes for pre-class preparation, and allocating class time for practical activities and quiz completion (Lee, 2023). He later named this method 'The Classroom Flip' (Baker, 2000). Baker highlighted the educator's role in FC to be changed from "sage on the stage" to "guide on the side" (Baker, 2000, p. 11). Likewise, the Economics educators at Miami University, Lage et al. (2000) coined the term 'inverted classroom' to describe a pedagogical approach that included online lecture videos, reading materials, and printable slides as pre-learning resources and the in-class sessions focused on active discussions on complex concepts and collaborative work in small groups (Ahmed, 2016). The educators defined "Inverting the classroom means that

events that have traditionally taken place inside the classroom now take place outside and vice versa" (p. 32) and viewed it as a robust instructional method offering individualized learning as per the learners' needs and style of learning (Lee, 2023).

In the context of school education, in 2007, Bergmann and Sams began flipping their chemistry classes at Woodland Park School in Colorado to support students who were slow learners or had missed classes. The educators used short online lecture videos for initial learning at home, followed by extended in-class discussions, experiments, and collaborative work, providing proper feedback and support to foster higher-order learning (Bergmann & Sams, 2012). The practitioners defined FC as an instructional method "where work that was traditionally done in the class is now done at home, and what was traditionally homework is now completed in the class" (p. 13). They found the model effective than lecture formats for in-depth comprehension, higher-order learning, and performance. Similarly, Lo and Hew (2017) express, "The basic notion of the flipped classroom approach is to deliver the teacher's lectures before class through online videos, to free-up the in-class time for active learning and problem-solving activities" (p. 1). The aforementioned views on FCA show its evolving concepts.

Out of the FC concepts mentioned above, the first three focus on the reallocation of tasks across different temporal and spatial contexts rather than on the key aspects such as student-centeredness, self-regulation, autonomy, and engagement. In contrast, the last definition emphasized these critical aspects, including shifts in time and space, and seems more comprehensive than the former definitions. Moreover, Abeysekera and Dawson (2015) considered flipped learning as a type of blended learning that combines online text-based activities at home and face-to-face lectures within the classroom. Thus, based upon the previous discussions, the FCA can be defined as an emerging, technology-based, active instructional model focused on personalized out-of-class learning through online video lectures and related resources combined with extended in-class interactive activities to apply knowledge under the instructor's guidance for in-depth learning.

Students' Performance Using FCA in Mathematics

As previously stated, FCA, being a technology-based learner-centered instructional method, is viewed as effective in creating positive learning outcomes in mathematics. In this regard, many reviewed studies have indicated the FC's positive impacts on students' performance in mathematics as compared to the lecture methods (Bhagat et al., 2016; Casem, 2016; Heuett, 2017; Hwang & Lai, 2016; Ku et al., 2019;

Lopes & Soares, 2018; Sopamena et al., 2023; Wei et al., 2020) by enhancing conceptual understanding (Sari et al., 2019; Sharkia & Kohen, 2021), problem-solving skills (Abeyseker & Dawson, 2015; Cevikbas & Kaiser, 2020, 2022), and critical and creative thinking (Musdi, 2022; Patterson et al., 2018). The studies also depicted that positive performance is further supported by improving learning motivation (Chen et al., 2016; Sharika & Kohen, 2021), engagement (Cevikbas & Kaiser, 2022; Rahman et al., 2016), self-confidence (Ford, 2015), and by facilitating independent learning (Ramadhami & Fitri, 2020), in-class interactions, in-person feedback, scape-folding, extra class time, and peer learning (Cevikbas & Kaiser, 2020; Lo et al., 2017). Conversely, some FC studies in mathematics education have found no positive or low impacts on students' performance compared to lecture methods (Clark, 2015; Strayer, 2012). The inconsistent performance can be attributed to suboptimal design and the classroom activities followed in FCs (Fung et al., 2021), including students' unpreparedness for pre-class materials and unfamiliarity with the model (Lo et al., 2017). Nevertheless, when appropriate design, instructional activities, and evaluation techniques are employed, students become familiar with the strategy and easily access pre-class materials, the FC model can yield beneficial effects on student performance in mathematics.

Students' Perceptions of Using FCA in Mathematics

Students' perspectives of FCA are essential for identifying its advantages and limitations and thereby enhancing its design, practice, and evaluation strategies within various educational contexts (Sen, 2022). In this context, many FC studies have reported students' positive perceptions, while fewer have indicated negative views.

Regarding the positive views, a considerable number of students have valued video lectures and related assignments for offering personalized learning and enhancing basic mathematical understanding (Heuett, 2017; Kiem & Keodavan, 2024; Lo & Hew, 2017; Lopes & Soares, 2018). Likewise, students have perceived improved social and digital skills, problem-solving skills, and creative thinking (Bergmann & Sams, 2015; Cevikbas & Kaiser, 2020, 2022; Kiem & Keodavan, 2024; Kostaris et al., 2017). Further, they viewed flipped pedagogy as more engaging, motivating, self-directed, and effective than conventional approaches (Unal & Unal, 2017). This preference is attributed to FC's provision of flexible self-study opportunities outside the classroom, coupled with active learning experiences during class that are facilitated by both instructors and fellow students (Lo & Hew, 2017).

Conversely, certain studies have noted students' negative perceptions of using FC in mathematics (e.g., Boevé et al., 2017; Strayer, 2012). Their negative expressions include unfamiliarity with FC (Lo et al., 2017), no habit of pre-class preparation (Kiem & Keodavan, 2024), problem of accessing pre-class materials, lengthy videos, and absence of immediate feedback during pre-class learning (Clark, 2015; Lo & Hew, 2017). However, the proportion of students expressing negative perceptions is relatively low, with only a small percentage reporting issues such as a lack of study habits or watching videos being time-consuming, regardless of the instructional model used (Unal & Unal, 2017). In sum, it can be concluded that effectively implemented FC pedagogy can ensure students' positive perceptions regarding its learning opportunities, environment, quality learning, and social skills developed.

Theoretical Framework

In this study, for designing and implementing FCA in the BM classroom and ultimately investigating students' performance and perceptions, the FC framework, design principles, and social constructivist learning theory presented below are considered as theoretical frameworks.

Flipped Learning Framework and Design Principles

Various FC frameworks and design principles have been discovered, establishing the model as an effective and practical approach for all educational levels and subject areas (Birgili et al., 2021; Cevikbas & Kaiser, 2020; Lee, 2023). Some of the framework and design principles crucial to conducting this study are presented below.

The basic framework of the FC model is a four-pillar F-L-I-P framework proposed by the Flipped Learning Network™ (FLN) (2014). The flexible environment (F) indicates that the educators need to adjust the flexible teaching-learning environment to meet the unique needs of each lesson or unit, promoting both independent and collaborative work that supports students' time, place, and pace for learning. The learning culture (L) focuses on adopting a learner-centered instructional approach within classrooms where learners actively construct their knowledge through interactions, discussions, and collaborative activities. The educator's role is to facilitate and evaluate students' learning, offering them feedback and guidance if necessary. Likewise, the intentional content (I) highlights the educator's decision for the topics to be addressed and the materials to be delivered based on learners' needs. The professional educator (P) highlights the educators' demanding role in designing and implementing pre-class and in-

class activities, engaging students in the activities, evaluating their work, and providing proper feedback (Hamden et al., 2013; Patterson et al., 2018). In this research, the FLIP framework was assumed to be essential for creating an effective FC environment, managing pre-class and in-class activities, engaging students in independent and collaborative activities, and evaluating their learning progress and perceptions toward the FC approach, as stated by Muir & Geiger (2015).

Likewise, the nine design principles recommended by Kim et al. (2014) were considered significant for creating a productive FC model in the selected topics of BM under this study, and then exploring how students viewed the model. The principles include: providing online lecture videos, encouraging students to prepare for in-class activities, managing assessment methods, linking in-class and out-of-class activities, offering proper guidance and sufficient time for assignments, fostering a learning community, providing immediate feedback, and using accessible technology. Furthermore, for effective flipped classrooms in mathematics, the three-stage model suggested by Fung et al. (2021) remained suitable for this research. This model highlights pre-class interactive materials, a brief in-class review of delivered content, and the interactions through discussions, problem-solving, teacher feedback, and peer collaboration, which supported implementing FCA in the BM course and answered the research questions.

Social Constructivist Learning Theory in FCs

As the FC model is considered a student-centric pedagogical approach, offering interactive, independent, and collaborative teaching-learning environments, it primarily appears rooted in Vygotsky's social constructivist theory of learning (Ahmed 2016; Jarvis et al., 2014). It is evident because this model potentially enhances students' comprehension and higher-order abilities through active participation, collaboration, social interaction, and communication (Bergmann and Sams, 2012, 2014; Cevikbas & Kaiser, 2020). Moreover, the FC format allows teachers to offer differentiated instructional experiences and provide guidance and support to the learners as per their needs. In this sense, the FCA suits closely with Vygotsky's (1978) social constructivist theory of learning. This theory highlights learners' active role in constructing knowledge and meaning of their world through engaged interactions with teachers and peers, and participation in active learning activities (Bishop & Verleger, 2013). Vygotsky (1978) outlined that learning becomes most effective when it occurs within the learner's zone of

proximal development (ZPD), with the help of more knowledgeable others (MKO). In this sense, this theory provides a significant foundation for effectively conducting flipped classrooms in the course, as well as for selecting methodological choices, analyzing data and supporting findings. Thus, this theoretical lens was considered a significant base for the study.

Methodology

This research followed a case study design to examine students' performance and perceptions of the FC model in educating the BM contents: quadratic equations, matrices and determinants, and systems of linear equations. The course enrolled 40 students, and the FC model was applied for four weeks. According to Coomb (2022), to comprehend a contemporary issue or phenomenon in a bounded system in depth, case study design is mostly preferred. "A bounded system refers to a single individual, group, event, organization, or any other phenomenon that the researcher is focusing on" (Coomb, 2022, p. 2). Likewise, Yin (2018) states that case study design is mostly adopted when the researcher needs to answer "how," "why," and "what" questions. As the applied FC strategy is a phenomenon, the course, class size, study period and the institution represent a bounded system, and students' perceptions and performance of FCA is an issue, the case study design better suits this study. Additionally, the study's "what and how" questions also indicate the appropriateness of the design selected.

Before conducting the research, the students were informed about the FC method, its working strategies, importance and objectives. Thereafter, the researcher provided YouTube video tutorials and related assignments on the topics one day before taking the class. All these materials were shared online with the student-created WhatsApp group, and they were required to view the videos and complete the assigned work before attending class. The assignments were instrumental in evaluating students' comprehension, identifying misconceptions and common errors, and encouraging their active participation in learning. The in-class sessions followed a short review of pre-class contents, clarification of students' misconceptions led by the educator, as well as discussions and solving exercise problems in small groups, allowing peer support and educators' frequent guidance and feedback, as suggested by Fung et al. (2021).

After adopting the flipped model for four weeks, the researcher collected relevant data and information related to students' performance and their perceptions of the applied FCA through conducting a test based on FWU's testing standards, a survey and a focus group discussion among purposively selected six student participants (pseudonymized A, B, …, F). The survey questionnaire included 14 items, of which 12 items were measured on a Likert scale (as used by Salami, 2024), allowing students to show their agreement on various aspects of the model. The responses were recorded using a 5-point scale, ranging from 0 (strongly disagree) to 4 (strongly agree). The remaining two items aimed to capture students' views about the most liked and least liked aspects of the strategy. The 30 students who attempted the test had also responded the questionnaire. Additionally, taking the participants' consent, the focus group discussion (FGD) was audio recorded and key points were noted. The quantitative data gathered were analyzed using descriptive statistical methods, and the recorded data, after transcribing, were analyzed via a thematic analysis procedure. Moreover, the survey and FG information were triangulated to confirm the findings.

Findings

The findings from data analysis are presented below according to the research questions.

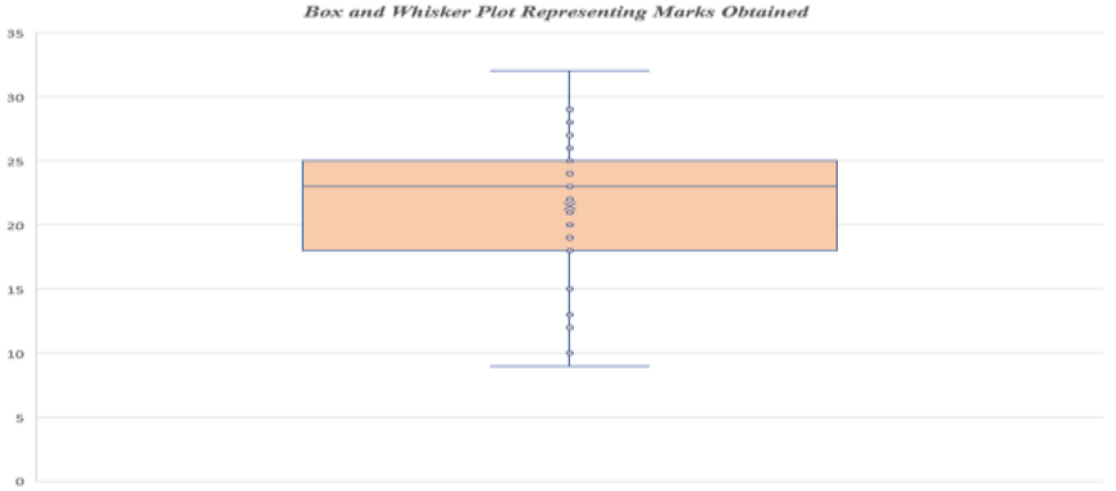
Research Question One

What performance do the students show when applying the FC approach in the BM course?

The descriptive statistical analysis of test scores out of the full mark 34 and the pass mark 15.3 showed that 87 % of total students remained successful in the test with central tendencies $\overline{X} = 21.5,\ M_d = 23,\ M_o = 23$. As the modal mark is above the mean mark, and both are higher than the pass mark indicate positive performance of the FC model. Similarly the five-number summary of the scores obtained is $X_S = 9, Q_1 = 18, M_d = 23, Q_3 = 25, X_L = 32$ with first quartile above the pass mark and the left-skewed score distribution represented by box-plot (Figure 1) confirms the students' positive performance in the applied FCA.

Figure 1

Box and Whisker Plot Representing Marks Obtained



Research Question Two

What are students' perceptions of the FC model in the BM course?

Table 1

Students' Agreement or Disagreement About Flipped Classroom

S. No.	Statements	Mean	SD	Remark
1	Flipped Classroom (FC) offers comprehensive and effective learning.	3.12	0.6	Accepted
2	It facilitates out-class personalized learning.	3.44	0.58	Accepted
3	This method offers active collaborative learning.	3.24	0.43	Accepted
4	FC offers teacher's feedback and peer support.	2.96	0.73	Accepted
5	It provides extra time for interactive in-class learning.	3.0	0.65	Accepted
6	This model develops 21st century skills.	3.28	0.54	Accepted
7	Flipped method enhances communication skill.	3.16	0.63	Accepted
8	It improves relationships with teacher and peers.	3.08	0.70	Accepted
9	FC enhances teacher and student technical skills.	3.16	0.63	Accepted
10	I would prefer FC for all courses	3.08	0.64	Accepted
11	Students should be more responsible for effectively adopting FC.	3.4	0.65	Accepted Accepted
12	Digital infrastructures and teacher's digital skills should be improved by the institutions.	3.48	0.59	Accepted
	Grand Mean	**3.2**		**Positive**

Table 1 shows mean values (M) and SD of students' agreements regarding various 12 aspects of the employed FC model where he mean value ranges from a minimum of 2.96 (for interactions, teacher feedback and peer support in the FC) to a maximum of 3.48 (for developing digital infrastructures and skills to improve flipped approach) and value of SD ranging from 0.43 to 0.73 showed students' positive agreements regarding the aspects. Moreover, the overall mean of the agreements, 3.2, has indicated students' positive perceptions toward the flipped approach.

Likewise, learners' most preferred aspects of FC are: the model remained supportive for low ability students (98%) and offered self-paced pre-class learning through lecture videos (96%), extra time for interactive in-class activities (80%), and teachers' feedback and peer support during classroom activities (72%). Thus, maximum learners preferred the flipped strategy's learning opportunities, which could be due to their agreement of getting individualized and group-based in-class learning opportunities where peer support and the teacher's regular guidance were more frequent in the applied FC approach (Table 1).

Table 2

Students' Most Liked Aspects of the FC Method

Statements	Percentage
Learning through lecture videos is much more interesting and self-paced. (I can pause and rewind as per my need)	96%
Video lectures are effective in understanding the content before going to class.	96%
Teacher's feedback, peer support and in-class interactions	72%
It provides enough class time for interacting with the teacher and peers and getting a clear understanding of the content	80%
Low-ability students get enough chances to learn within and outside the class.	98%

Table 3 shows that some students (20%) liked pre-class lecture videos least because they perceived them as time-consuming and difficult to understand. Similarly, 16% of students did not like FC's pre-class learning because they had no habit of watching videos before class and preferred learning in class. It could be due to the others' videos and the students' lack of responsibility in learning.

Table 3

Students' Least Liked Aspects of the FC

Statements	Percentage
I am not used to learning from videos before taking class. I like learning in class.	16%
Watching lecture tutorials was time-consuming, and the language was difficult.	20%

Research Question Three

How do students perceive the FC approach in the course?

To explore the students' experience and feelings about the FCA in-depth, an FGD was conducted. The discussion, based on the students' survey questionnaire agreements and opinions, revolved around three questions: How do you perceive the model as effective for your course? How do you feel about adopting the FC method challenging? How do you think this model can be effectively implemented? The three themes developed through qualitative analysis are presented below.

Perceptions of the Effective Flipped Model

In responding to the first question, all six participants appreciated the model for effective learning, providing pre-class basic learning via lecture videos and in-class comprehensive learning through interactive and collaborative activities under the guidance and feedback from the teacher and peers. They further viewed the model as beneficial for developing higher-order abilities, including social and digital skills. In this regard, participant A expressed, “Videos are supportive to learn at my own pace and time”. Participant B mentioned, “Pre-class assignments have made me a self-responsive learner”. Likewise, participant F asserted, “I couldn’t understand and solve problems before, but at present, the flipped environment has enabled my problem understanding and solving ability”. Participant C claimed, “It is a suitable learning method for the digital era students because they need to develop higher-order competencies to sustain successful professional, personal, and social lives”. Participants E and D echoed that the model remained effective in developing social and digital skills, as it prefers learning through collaboration and using technology. As these positive expressions about the FC model align well with the findings of the survey, it can be concluded that students have overall positive perceptions of the FC environment.

Perceptions of Flipped Model Challenges

Concerning the challenging aspects of the flipped approach, all the participants viewed that the lack of a proper flipped learning environment in terms of digital and physical infrastructures for in-class interactive learning, teachers' digital competencies, and students’ motivation and self-regulation, as the major issues for productive adoption of the approach. In this line, participant E expressed, “Students may not hold control over their learning as they can be distracted by the entertainment videos available online. Similarly, participant F stated, “YouTube videos create language and understanding

difficulty, and take much time to watch lengthy lectures. Teachers' clear and concise lecture videos could be more effective for learning". Thus, digital technology, physical infrastructures, teachers' digital skills, self-responsive and motivated learners, and quality lecture videos were key challenging issues related to the effective practice of FC. The above survey findings related to negative aspects of FC also align with these FGD findings.

Perceived Feedback for Effective Practice FC Model

Regarding the effective practice of the FCA, all the participants expressed that the institutions should establish proper digital and physical infrastructures and develop teachers' digital skills. In this line, participant E expressed, "We could better engage in in-class group work if managed round-table seating arrangements". Participant A stated, "An interactive digital board and reliable internet could facilitate interactive classroom learning". They also perceived teachers' crucial role in creating a proper FL environment by preparing quality lecture videos, making the materials accessible to pupils in time, encouraging them for independent and group-based learning, managing active learning activities, and employing effective evaluation strategies. The findings depicted in Table 1 (related to survey items 11 and 12) closely support these FGD findings.

Discussion

The findings revealed that students had positive performance in the flipped BM course. Such a performance could be influenced by the implemented framework, principles and social constructivist approaches to learning (Vygotsky, 1978). Likewise, pre-class materials and related assignments, individualized and collaborative student-centric learning environment, along with peer support and educators' guidance that students had perceived in the flipped approach, could have benefited their results. Besides, more focused in-class interactions and problem-solving activities might have created the high performance. A similar finding was observed by Casem (2016) and Lopes and Soares (2018), who reported that the employed flipped approach significantly enhanced the students' performance in mathematics, as it allowed students to prepare more effectively for class sessions and provided greater opportunities for interacting with the instructor and their peers compared to conventional lecture formats. Likewise, the finding agrees with Cevikbas and Kaiser (2020) and Heuett (2017), who revealed that applied flipped classrooms provided significant opportunities for enhancing students'

understanding, mathematical thinking, problem-solving abilities, and performance due to the notable changes in tasks, discourse, feedback, scaffolding, and the learning environment. Thus, based on these discussions, students' positive performance in this study seems evident.

The students' positive perceptions of the adopted FCA seem evident because they attributed the model as effective for improving their content comprehension, problem-solving abilities, social and digital skills, relationships with peers and teachers, and more beneficial for students with low proficiency levels, which is echoed by Bergmann & Sams (2012, 2014, 2015). Moreover, they viewed the flipped model as suitable for digital-era learners to meet their needs, and preferred it for other courses. Some studies have reported that students favor FC due to its flexible self-study options that extend learning beyond the classroom, alongside engaging in-class activities, feedback, and guidance provided by educators and peers (e.g., Cevikbas & Kaiser, 2020, 2022; Lo & Hew, 2017), which aligns with this study's findings. Moreover, Lopes & Soares (2018), in their FC study on Financial Mathematics, found that student attitudes towards this approach tend to be favorable, as it allows for more interactive and collaborative classroom activities, which supports current findings. The participants' view of developing digital skills in this study is consistent with Kostaris et al. (2017), who assert that working with digital learning resources enhances students' digital competencies. Similarly, the students' perceptions regarding 21st-century skills converge with Zao et al. (2021), who highlighted the FC strategy as crucial for developing students with the essential 21st-century skills needed to address global challenges and fulfil contemporary market demands. Furthermore, the participants' acceptance of the flipped method for other courses is supported by Salami (2024), who noted that students viewed the flipped classroom as both sustainable and applicable across all academic levels and courses. In sum, the students' positive perceptions of the applied flipped model in this study are well justified.

The findings also indicated that a minority of students have negative perceptions of the FCA, specifically regarding the lack of a habit of learning through videos, and the perceived time-consuming nature of videos, which creates language difficulty. This finding agrees with Unal and Unal (2017), who reported that a small portion (11.25%) of students (623) had no habit of learning at home, and 8.77% had experienced lengthy videos. Likewise, participants identified the lack of digital and physical infrastructures,

digital access, teachers' digital skills, quality pre-class learning materials, and self-regulated learners as key issues for the effective practice of the flipped model. In support of this finding, Lo and Hew (2017) indicated the three types of challenges related to students, teachers, and technology while applying the flipped approach. In response to the perceived challenges, students' feedback for the effective adoption of this approach indicates that the institutions should establish digital and physical infrastructures, develop educators' digital competencies for creating quality lecture videos and students need to be self-responsive for their learning. In this regard, Bergmann and Sams (2012, 2014) and Bishop and Verleger (2013) highlighted the institutional authority and the educator's key role in creating a productive flipped learning environment, and motivated and self-responsive learners, which justifies the finding.

Conclusion

The Flipped Classroom model is an effective educational approach in higher education that addresses students' diverse academic needs by improving higher-order thinking and problem-solving skills. The present case study investigated that students secured positive performance of FCA in the BM course at FWU's campus in Nepal, and they positively perceived the FC model. Students' positive perceptions of the strategy were mostly attributed to its effectiveness in enhancing their content comprehension, problem-solving abilities, communication and digital skills and relationships with peers and teachers. Moreover, students viewed the model as suitable for digital-era learners and preferred it for other courses. The findings also indicated that physical and digital infrastructure facilities, digitally skilled teachers, self-responsive students, and educators' quality lecture videos were perceived as essential for effective flipped classroom practice. The study seems significant for university authorities and educators to encourage adopting a flipped approach to impart quality education and develop competent academic products. Likewise, this research can be crucial to support scholars conducting studies in Nepalese educational settings, thereby filling the gap in the existing literature. The study suggests further extended and rigorous research in this area to ensure more valid and generalized findings.

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