Journal of Pedagogical Sociology and Psychology
Volume 7, Issue 4, 2025
https://doi.org/10.33902/jpsp.202533603

Research Article

Exploring Bhutanese students' perceptions of flipped classroom instruction in biology

Sonam Dorji[1], Sangay Zangmo[2] and Kinzang Dorji[3]

[1]Department of Science, Tang Central School, Bumthang, Bhutan; [2]Department of Mathematics, Tang Central School, Bumthang, Bhutan; [3]Department of STEM Education, Samtse College of Education, Bhutan

Correspondence should be addressed to Sonam Dorji sdorji123@education.gov.bt
Received 28 January 2025; Revised 3 June 2025; Accepted 12 June 2025

This study explored the perceptions of Bhutanese students regarding flipped classroom (FC) instruction in biology. A total of 52 Grade 10 students from a central school in Bumthang district were selected using a cluster sampling design. The participants were naturally assigned to either the FC group or the Conventional Group (CG). While students in the FC group received instruction through flipped classroom strategies, those in the CG were taught using the traditional lecture method. Data collection involved a pre- and post-test Biology Achievement Test, a 5-point Likert scale questionnaire, and a semi-structured interview protocol. The pre- and post-test data were analyzed using independent samples *t*-tests, whereas the questionnaire data were examined through descriptive statistics. Additionally, Pearson correlation analysis was conducted to explore the relationship between students' academic achievement and motivation. The results from the *t*-test revealed a statistically significant difference in achievement between the FC and CG groups, favoring the flipped classroom approach. Descriptive findings further indicated that students held positive perceptions of FC-based instruction in biology. The approach was shown to enhance students' interest, motivation, and self-confidence. Moreover, regression analysis confirmed a significant positive correlation between students' motivation levels and their academic performance. Overall, the findings suggest that the flipped classroom approach can serve as a more effective alternative to traditional teaching methods in Bhutanese secondary science education, with potential to foster improved student engagement, confidence, and academic outcomes.

Keywords: Bhutanese students, biology, flip class, mixed method, perceptions

1. Introduction

Despite the remarkable progress and developments that the education system in Bhutan has witnessed over the past decades, the declining trend of quality education is still an issue of concern at all levels of Bhutanese societies. To this end, recently, the Ministry of Education [MoE] has provided the nationwide teachers' professional development program on the 21st century transformative pedagogy in 2016 that intended to address the educational needs of the nation and to equip all levels of teachers with the concepts of student-centered learning, knowledge-based learning, assessment-based learning and community-based learning (Wangdi, 2016).

Despite the ministry's initiatives and efforts made on the 21st century transformative pedagogy, the academic achievements of students in science subjects continue to show poor performance at the secondary level schools. For instance, the past five years of (2014-2018) records of the Bhutan Council for School and Examination and Assessment [BCSEA] result analysis revealed that grade 10 students have consistently shown poor performance in the overall science subjects (i. e., mean scores < 60 %), and biology is the least among the science subjects (52.22%), although this subject is the scoring subject. In addition, the Annual Performance Agreement [APA] of Bumthang District also showed that the grade 10students' mean scores in biology (56.6%) were below the set target (60%) of the district's commitment in the educational sector. Through our classroom teaching experiences, the traditional notion of classroom teaching practice still widely exists in the Bhutanese classroom teaching, thus attributing to rote memorization learning. However, the use of FC (Bergmann & Sams, 2012; Dorji & Dorji, 2022) revealed that it increases the availability of class time and enhances the academic performance of the students in learning the science classes.

Therefore, there is a need for us to devise new approaches that can be used to address these issues. The approaches must be tested, researched, and elucidated to ensure applicability in the Bhutanese classroom context.

The concept of the FC is not new. Distance education used instructional videos to deliver content before the FC. For instance, In the 1920s, television and radio were used as new technologies to deliver education in most advanced countries. Similarly, in the 1960s, Open University in the United Kingdom became the most outstanding, full-scale effort to use video to deliver educational content. Open University (University of the Air) programmed distance education through television every morning in the United Kingdom, Canada, and Australia (Overmyer, 2014).

King (2016) in his study from Sage on the Stage to Guide on the Side, emphasized the importance of the use of class time for interactive learning rather than teachers transmitting the information. Moreover, the author claimed that FC as an interactive tool enhances the educational space for active learning. In this connection, Cheng (2024) played a significant role in the development of concepts influencing FC through the development of an instructional approach known as peer instruction.

The University of Wisconsin-Madison used software to substitute lectures in an extensive lecture-based computer science program with a streaming video of the lecturer and systematic slides (Foertsch et al., 2002). This contributed to the enhanced interest and motivation of students in the teaching-learning process. In 2004, Khan began to record videos and Khan Academy has become synonymous with the FC; however, these videos are only one form of the FC strategy (Thompson, 2011). Furthermore, Woodland Park High School chemistry educators Bergmann and Sams practiced flipped lessons in 2007, they captured their lectures and uploaded them online to support students who missed their classes. They went on to develop the "Flipped-Mastery" model and wrote extensively about it in their book Flip Your Classroom (Bergmann & Sams, 2012).

Johnston and Karafotias (2016) supported that FC has been effective in secondary schools and at the college level. Moreover, the FC allows teachers to engage students in innovative ways, and to apply a variety of modern teaching media and approaches. Thus, FC is useful in diverse classroom situations with students who have diverse learning preferences.

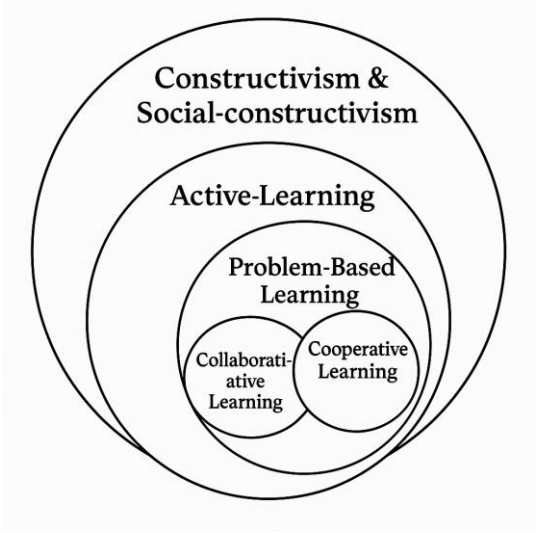
The University of Graz conducted a study by providing instructional videos and making them accessible to students throughout the semester. Later, teachers surveyed how students have used instructional videos that were provided as material to learn the content. The study revealed that most of the students (68.1%) relied on watching the podcasts but had low attendance rates compared to their podcast usage. Some students watched podcasts (19.6%) or somewhat used the podcasts (12.3%). Students who watched the videos more than their peers performed better than those who did not watch (Luttenberger et al., 2018).

Jurmey et al. (2019) the first group of teachers in Bhutan researched FC in the Bhutanese education system based on the conflict of time availability and syllabus coverage is one of the pressing issues. The study investigated 83 students' attitudes towards FC, based on class 12 English on the topic, "Lamb to the Slaughter". The study revealed that the FC saved an average of 13.29% of instructional hours without affecting students' learning. FC proved to be very effective in managing the instructional hours. Despite reducing the instructional hours, students' learning was not compromised in implementing the FC. As for the students' attitude, they were very positive about the use of FC in their daily teaching-learning sessions. Students agreed with the full conviction that they prefer FC over the traditional teaching method. They felt that the instructional hours were more interactive, engaging, and motivating (Dorji & Dorji, 2022).

FC is a dynamic instructional model that merges active, problem-based learning rooted in constructivist theory with direct-instruction lectures—creating a powerful blend of student-centered and behaviorist methods. Recent studies in teacher education and mathematics demonstrate that it not only boosts academic performance and participation but also enhances scientific-process skills and motivation. For instance, Ergene and Karaboğaz (2024) found that flipped instruction significantly improved middle-school students' proportional reasoning, while

Acar and Özler (2024) showed notable increases in achievement and self-regulation in primary education. This suggests that FC leverage teaching and learning theories. For instance, Figure 1 depicts Flipped Learning as multiple ways to enhance student-centred learning based on theories/methods. It is student-centred as learning is based on active learning, constructivism/ social constructivism, and its components, namely peer-assisted, collaborative, cooperative, and problem-based learning support students in taking part in activities in and out of the class.

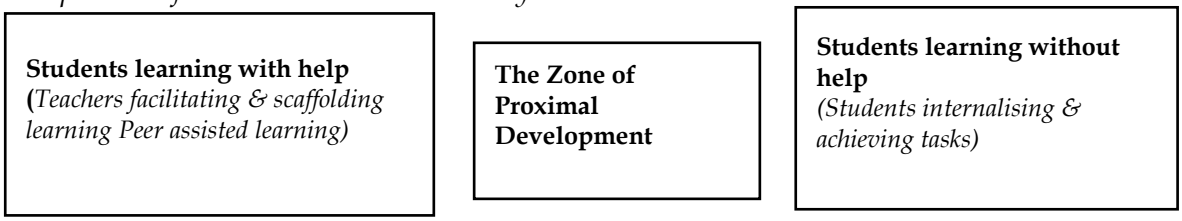
Figure 1
Student-Centred Learning Theories/Methods



Note. Adapted from The Flipped Classroom: A Survey of the Research (Bishop & Verleger, 2013, p.7)

In FC, students engage in learning at home prior to learning in the class the constructivist definition of student-centred learning is implied. Learners also use their past experiences and knowledge to build an understanding of the new material, implying an equally socio-constructivist approach. From both the constructivist and socio-constructivist perspectives, learners actively construct their knowledge aided by teachers' scaffolding and collaborative or cooperative dialogue with peers (Chen & Chen, 2015). Constructivism and collaborative learning stem from Piaget's theory of cognitive development; cooperative learning originates from Vygotsky's zone of proximal development [ZPD] which Vygotsky (1978, p.86) defined as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development under adult guidance, or in collaboration with more capable peers". ZPD emerges as students learn to perform new tasks through interaction with peers or teachers. After that students internalize these tasks so that they can learn on their own without help (Figure 2).

Figure 2
Components of Social Constructivist Theory that are Evident in the FC



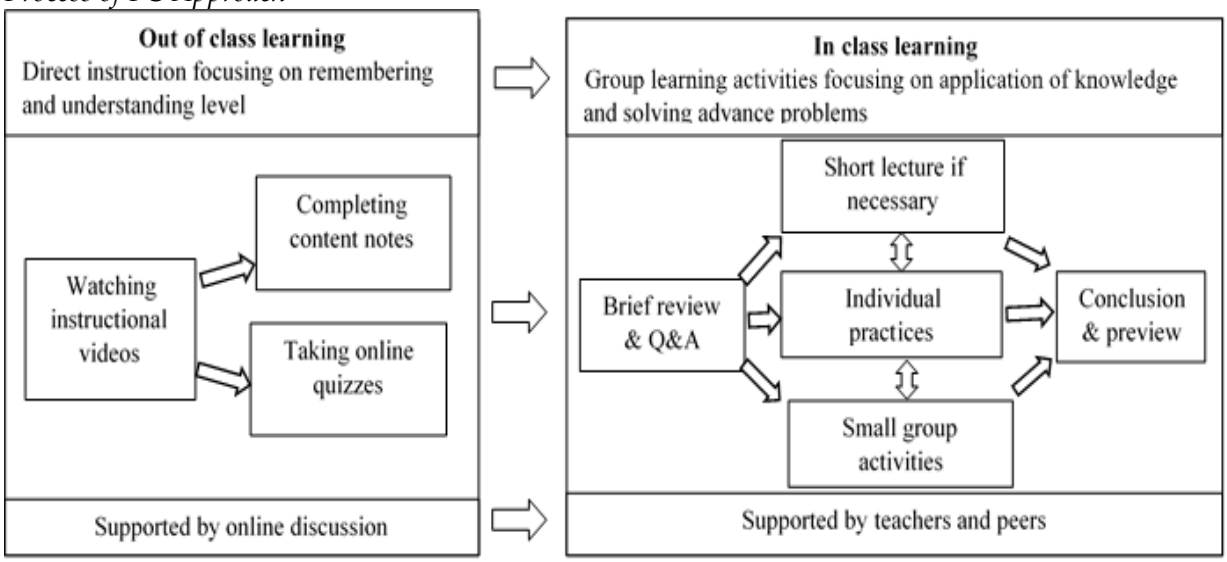
Note. Adapted from Mind in society: The development of higher psychological processes (Vygotsky 1978, p.86)

Learning becomes effective when students take active participation in a learning task (Chen et al., 2014). Cavanagh (2011) argued that the FC is appropriate for active learning tasks, featured by some elements such as student-centred learning, discovery/exploration, a sense of structure, and

the use of technology. Additionally, in FC, students can carry out their homework activities as a form of active learning. They can also collaborate, cooperate, and enter discussion with their teachers and peers (peer-assisted learning). Problems associated with a lesson, or concepts are introduced prior to class and are used to provide the context and motivation for the learning that follows in class. This is why FC is the problem-based method. However, critics argue that although the theoretical underpinnings of the FC emphasize active, constructivist strategies like scaffolding, peer-assisted learning, and collaborative problem-solving, its practical implementation often prioritizes technology-driven tasks over these pedagogical methods (Bishop & Verleger, 2013; Erbil, 2020).

According to the literature, the FC is defined as the strategy through which, what is done at school is done at home and homework done at home is completed in class (Bergmann & Sams, 2014; Crouch & Mazur, 2001; Lage et al., 2000). Furthermore, Kim et al. (2014) elaborated that in FC, as indicated in Figure 3 before the class, students watch the lesson through multiple devices such as online videos, presentations, learning management systems, and take notes, and prepare questions about the parts that are not clear. During the class hours, students and the teacher achieve supporting activities such as finding answers together to the questions they prepared before the lesson, group work, problem-solving, discussion, and making an inference (Formica et al., 2010).

Figure 3
Process of FC Approach



Note. Adapted from Research and Practice in Technology Enhanced Learning by (Lo & Hew, 2017, p.13)

The FC is more engaging than the traditional classroom, and most students have positive attitudes toward this new mode of teaching and learning. For instance, Jurmey et al. (2019) at Shari Higher Secondary school in Bhutan, Nouri (2016) at Stockholm University in Sweden, and Zainuddin and Attaran (2016) in Malaysian classrooms, whose findings reported that students preferred FC over the traditional lecture method. The study revealed that the students agree that the FC is a unique experience. Many students stated that it helps in a better understanding of the concept, more participation, greater opportunities, additional learning, further interaction, and better engagement during the instructional hours.

The study findings will serve as baseline data to inform teachers and other relevant stakeholders about students' conceptual understanding of biology education through FC as a means of intervention. The finding will disclose the FC as a teaching educational approach to improve teachers' way of teaching biology and other subjects. Furthermore, the study will provide findings based on students' perceptions towards FC as a tool of intervention for developing their positive perception towards biology education. Moreover, the findings will also help to redefine

the role of the biology teachers in imparting the lesson on biology. As a result, this study will help to provide research-based information for the relevant stakeholders such as education colleges, policymakers, school biology teachers, and Royal Education Council [REC] in the education system. In Bhutan, FC is a new concept in the teaching-learning process. Therefore, this study investigated the perception of the students in teaching and learning biology employing FC at the secondary level schools in Bhutan.

2. Methodology

2.1. Research Design

The research was based on explanatory sequential methods, which allowed the researcher to collect and analyse quantitative data first and build on the quantitative results to explain in more detail qualitative data. According to Creswell (2014), the study data collection based on explanatory sequential methods (i.e., initial quantitative phase is followed by the qualitative phase) increases confidence in research data, creates innovative ways of comprehending the process, exhibits different findings, and contributes to a clearer understanding of the problem.

For the quasi-experiment, two sections were randomly selected for the study. Both the Flipped classroom group [FCG] and control group [CG] were administered pre-test at the beginning of the study to examine the baseline. In FCG, students were taught the topic of cell division using the FC. For instance, during the instructional hours, students completed their home-works and high order thinking questions in the classroom, with support from peers and guidance from the subject teacher. Moreover, students learned the content out of the class during the free hours using learning platforms such as nearpod, google classroom, and exe-web authoring tools. Interactive videos based on the cell division assisted students to master the content and they were able to view the video again and again. Similarly, open forum discussions were also created for students to share learning experiences and understanding of the concept that they have learned out of the class.

On other hand, CG was taught with the traditional lecture method. Students learned the content in the class, follow up activities such as homework and high order thinking questions were assigned to students to be completed, applying the concepts that they have learned in the class. Therefore, in CG, the teacher was the center of the knowledge and students were consumers of the knowledge.

Finally, a post-test was administered to both groups to examine the effectiveness of the intervention. For the FCG, four students participated in the semi-structured interview. The questions were designed based on content on the topic of cell division and students' perception towards the FC.

2.2. Participants

A total of 52 grade 10 students from one of the central schools from Bumthang district participated in this study. Each section had 26 students from selected clusters. One of the sections of grade 10 was involved as an experimental group (FCG) and another one as the control group (Conventional Group). Every section comprised subjects with mixed abilities.

For a qualitative study, four participants were selected from the FCG after the intervention using simple random sampling. The participants were selected from FCG to investigate the effectiveness and participants' perception towards teaching and learning biology using FC. The questions for the semi-structured interview were designed based on the topic of cell division.

2.3. Data Collection

In this study, for quasi-experimental design, a pre-test was conducted to compare whether the FCG and CG were equal at the beginning of the intervention. Similarly, a post-test was conducted to evaluate whether the intervention has an impact on the Biological Achievement Test [BAT] at the end of the experiment. BAT questions were framed based on the Bhutanese Secondary School Biology curriculum 2016. In addition, some of the questions were adapted from Bhutan Certificate

Secondary Examination [BCSE]. The questions contain a good number of Competency-Based Questions [CBQ] to validate the learning outcome.

The quantitative data based on respondents' perception towards FC was collected through a closed-ended survey questionnaire that was adapted from Aljaraideh (2019) framed using a five-point Likert scale. It was administered to the FCG at the end of the intervention to investigate the degree of perception level of the respondents' perception towards FC in learning biology. A five-point Likert Scale was used to measure the level of respondents' perception.

The study used a semi-structured interview to find participants' in-depth conceptual understanding of the topic and their perceptions of FC in the Biology classroom. Four participants from the FCG were interviewed to evaluate the participants' conceptual understanding of the topic. The use of such an instrument helped the researchers to triangulate the data and make the findings more valid.

2.4. Intervention

The intervention was carried out using two distinct groups: the Conventional Group (CG) and the Flipped Classroom Group (FCG). The CG functioned as the control group, receiving traditional instruction to serve as a baseline for comparison. This group was taught the topic of cell division using the conventional lecture method over the course of one week. The instructional approach was teacher-centered, with the teacher delivering lessons in class through direct instruction. Following the lectures, students were assigned homework, project work, and higher-order thinking tasks to be completed independently at home, without additional support. In contrast, the FCG received instruction through the FC Approach, also over one week. Prior to class, students in the FCG were provided with learning materials including video lessons and PowerPoint presentations—uploaded on Google Classroom. These resources allowed students to engage with the content at their own pace during their free time. For students who lacked access to digital devices or internet at home or in hostels, arrangements were made for them to watch the instructional materials in the school's IT laboratory. During class, students in the FCG engaged in collaborative learning activities focused on higher-order thinking, with the teacher facilitating and guiding their work. Homework was completed during class hours, allowing for immediate feedback and support. Additional platforms such as Nearpod were also used to enhance learning through interactive and asynchronous video content. Students participated in online forum discussions initiated by the teacher, further reinforcing their understanding. To evaluate the effectiveness of the intervention, a pre-test was administered to both groups before the intervention, and analysis confirmed that both groups were comparable in ability. After the intervention, a post-test was conducted, and the results showed significant improvement in the FCG compared to the CG, indicating the effectiveness of the FC approach in improving learning outcomes in biology. Furthermore, students in the FCG expressed positive perceptions of the FC experience. To complement the quantitative findings, semi-structured interviews were conducted with four students from the FCG to gain deeper insights into their experiences and perceptions of the flipped learning model.

2.5. Data Analysis

The quantitative data were investigated using the Statistical Package for Social Science version 22. Similarly, the qualitative data were transcribed and analysed based on the approaches of Creswell's thematic coding technique (Creswell, 2014).

The biological achievement test was used as the dependent variable to examine the existence of statistically significant correlation based on the independent variable such as interest, motivation, and confidence. For instance, simple linear regression correlation was employed to investigate the significant levels between the variables.

The data analysis on respondents' perception towards FC was analysed with mean and standard deviation. The mean and standard deviation from the survey questionnaires were used to determine the level of perceptions based on the scale range. Furthermore, correlation and linear

regression were used to analyse the interest, motivation, and confidence as influential factors in learning biology using FC.

The semi-structured interview provided participants the freedom to communicate their opinions about the FC as interactive learning. To compare the effectiveness of FC in teaching biological concepts and also to explore the respondents' perception towards the use of FC in learning Biology, the data were coded and transcribed. Creswell (2014) suggests systematic process for data coding, categorization, and thematization were followed for data analyses.

In terms of students' perception of FC, the interpretation of the average perception scores of respondents concerning the Brown Model is displayed in Table 1.

Table 1
Interpretation of Respondents' Perception Mean Scores concerning Brown Model

Mean values	*Agreement*	*Level of perception*
4.51-5.00	Strongly agree	Highest
3.51-4.50	Agree	High
2.51-3.50	Neutral	Moderate
1.51-2.50	Poor	Low
1.00-1.50	Very poor	Lowest

Note. Adapted from *ANR Program evaluation* (Brown, 2010, p.1)

Descriptive statistical analysis was performed on factors affecting respondents' perception towards teaching and learning Biology using FC. Brown Model (2010) (see Table 1) was adapted to interpret the level of perception against each influential factor such as interest, motivation, and confidence.

3. Results

3.1. Test of Normality for Pre-test and Post-test Data

Table 2 shows the Shapiro-Wilk test results test of the normality for pre-test and post-test data of the test scores within the CG and FCG.

Table 2
Normality of Test Scores of CG and FCG

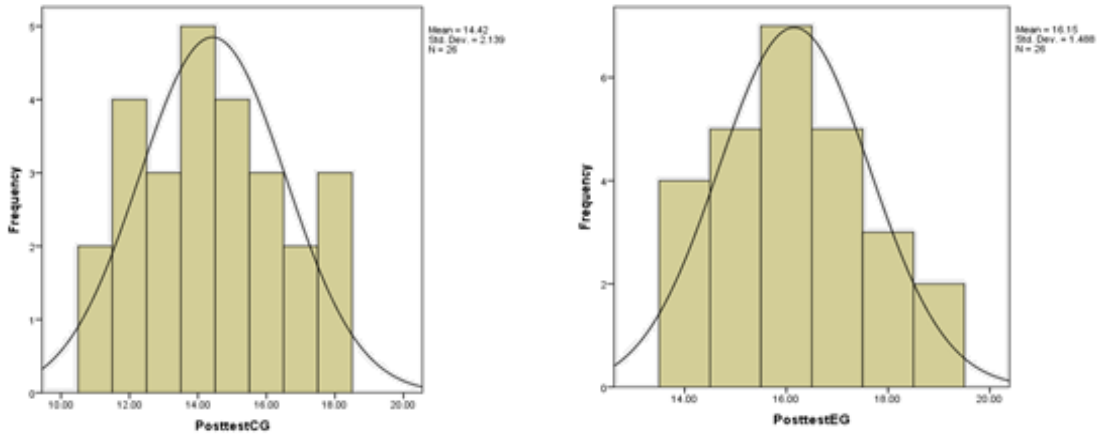
Tests and Groups	*N*	*p*
Pre-test		
CG	26	.457
FCG	26	.106
Post-test		
CG	26	.202
FCG	26	.101

The Shapiro-Wilk test was performed to examine the normality of the observed data using SPSS version 22. As shown in Table 2, the Shapiro-Wilk test of normality revealed that the pre-test and post-test data were normally distributed (Pre-test: CG, p = .457; FCG, p = 0.106; Post-test: CG, p = .202; FCG, p = .101).

The findings from Table 2 confirm that there is no significant deviation from normality in any of the test scores for both groups. This strengthens the reliability of subsequent statistical analyses and ensures that the comparison of means between the groups can be conducted using standard parametric techniques. Specifically, since all p-values are above the .05 threshold, it can be concluded that the data distributions are suitable for further inferential analysis.

Figure 4, the histograms illustrate the distribution of post-test scores for both the CG (left) and the FCG (right).

Figure 4
Histogram showing the Distribution of Post-test Scores of CG and FCG



The histograms compare post-test scores, showing the FCG achieved a higher average with less score variability compared to the CG. Both groups' scores appear roughly normally distributed, with the experimental group demonstrating a notably higher central tendency.

3.2. Analysis of Pre-test Data between CG and FCG prior to Intervention

Table 3 illustrates the independent sample t-test of pre-test scores between the CG and the FCG prior to the intervention.

Table 3
Independent Sample t-Test of Pre-test between Groups

Groups	*N*	*Mean*	*Mean difference*	*SD*	*Sig (2-tailed)*
CG	26	10.19	0.46	2.10	.437
FCG	26	9.73		2.15	

An independent sample *t*-test was performed at a 95% confidence interval to examine the prevalence of any statistically significant difference between the test scores of FCG and CG. The test indicated that there was no statistically significant difference (p = .437) between CG and FCG during the pre-test with a mean difference of 0.46, indicating that the distribution of students between CG and FCG were equally considered in terms of learning abilities before the intervention was made as indicated in Table 3.

The findings confirm that the two groups started from a similar baseline in terms of knowledge or skills assessed in the pre-test. This is essential for ensuring the validity of the study, as any observed changes in post-test performance can more confidently be attributed to the intervention rather than pre-existing differences. The small mean difference of 0.46 further supports the conclusion that the groups were well-matched prior to treatment.

3.3. Analysis of Post-test Data between the CG and FCG after the Intervention

Table 4 indicates the independent sample t-test of post-test scores between the CG and the FCG after the intervention.

Table 4
Independent Sample t-Test of Post-test between Groups

Groups	*N*	*Mean*	*Mean difference*	*SD*	*Sig (2-tailed)*
CG	26	14.42	1.73	2.14	.001
FCG	26	16.15		1.49	

Statistical result of an independent sample t-test subject to post-test data analysis indicated that there was a statistically significant difference (p = .001) between CG and FCG with the mean difference value of 1.73, indicating the effectiveness of FCA over the traditional method.

The significant difference in post-test performance reveals that students in the FCG benefited substantially from the instructional intervention when compared to those in the CG. The higher mean score and lower variation in the FCG imply not only better overall achievement but also greater consistency in learning among students. These findings provide strong support for the effectiveness of the FC approach in enhancing student academic performance.

3.4. Students' Perception of FC

3.4.1. Students interest

Table 5 summarizes the descriptive statistics related to respondents' interest in FC in the context of learning biology.

Table 5
Descriptive Statistics on Interest of Respondents towards FC in Learning Biology

Item No.	*Items*	*N*	*Mean*	*SD*	*Level of perception*
1	I like the flipped classroom approach.	26	4.73	0.45	Highest
2	I learn more if I have the pre-concept before the class begins.	26	4.50	0.58	High
3	I feel that watching videos, reading PowerPoint presentations, and taking notes to contribute efficiently to my learning.	26	4.58	0.64	Highest
4	FC matches my learning style.	26	4.42	0.58	
5	FC can improve interest in exploring topics.	26	4.62	0.50	High
6	FC can improve interest in the class.	26	4.73	0.67	Highest Highest
7	I frequently pause or repeat parts of the videos to increase my understanding of the material.	26	4.58	0.50	Highest
8	FC encourages me to practice critical and creative thinking.	26	4.46	0.86	High
9	Learning foundational content prior to class greatly enhances my understanding of the material.	26	4.00	0.89	High
10	FC allows asking more questions inside the classroom.	26	4.46	0.65	High
	Overall	26	4.51	0.32	Highest

The results of the descriptive analysis on respondents' factors (i.e. interest) indicated the overall mean value of 4.51 with the standard deviation of 0.32 (Table 5), which revealed that respondents possess the highest level of perception towards the use of FC as an instructional method. This interpretation was done by referring to the Brown Model (2010) as shown in Table 4.

The findings clearly indicate that students perceive the FC model as highly effective and engaging. Their enthusiasm for the approach is evident in their strong agreement with statements related to interest, personalized learning, and active engagement through video-based content. The high ratings for items on rewatching videos and enhanced understanding suggest that the flipped model supports diverse learning needs and allows for self-paced study.

Interestingly, although all items were rated positively, the item concerning foundational content had the lowest mean, suggesting that while students value having pre-class materials, they may still require more structured guidance or support in this area. Nonetheless, the overall perception

remains highly favorable, confirming the effectiveness of the FC in promoting active, student-centered learning.

3.4.2. Students' motivation

Table 6 shows the descriptive statistics on motivation of respondents' perception towards FC in learning biology.

Table 6
Descriptive Statistics on Motivation of Respondents towards FC in Learning Biology

Item No.	*Items*	*N*	*Mean*	*SD*	*Level of perception*
1	FC attracts my attention to the learning and teaching process.	26	4.65	0.49	Highest
2	With FC, I have to do more work out of the classroom.	26	3.85	1.01	High
3	I try to learn as much as possible while watching the videos.	26	4.62	0.50	Highest
4	I felt prepared to complete course tasks in class after listening to the video content.	26	4.46	0.58	High
5	FC is more engaging than the traditional classroom.	26	4.81	0.49	Highest
6	FC reduces the effort to understand the basic knowledge of the subject matter.	26	3.88	1.14	High
7	FC, along with the delivery of content outside class and problem-solving in class, is an instructional method appropriate for my learning.	26	4.27	0.72	High
8	I am more motivated to learn the concepts of course via the FC.	26	4.81	0.40	Highest
9	FC improved collaborative learning.	26	4.46	0.66	High
10	I wish more teachers use the FC.	26	4.77	0.65	Highest
	Overall	26	4.45	0.31	High

The relationship between the level of motivation and using FC was explored to examine whether such teaching and learning pedagogy influences the respondents' academic achievement in Biology. The finding indicated a mean value of 4.45 with a standard deviation of 0.31 (Table 6) indicating a high perception level of learner's motivation in FC in learning cell division. The interpretation of the result was based on the Brown model as shown in Table 4.

The findings suggest that the FC model is well-received by students, particularly in how it engages them, motivates learning, and facilitates better understanding and preparation. The strong preference for more teachers adopting this model (Item 10) further emphasizes student satisfaction. Although students recognize the increased workload outside the classroom, the positive outcomes in engagement and learning appear to outweigh this concern.

Overall, the results align with research suggesting that flipped learning can lead to more active, student-centered learning experiences, greater autonomy, and improved classroom interactions. These insights support the continued implementation and expansion of the FC approach in similar educational settings.

3.4.3. Students' confidence

Table 7 shows the descriptive statistics on confidence of respondents' perception towards FC in learning biology.

Table 7
Descriptive Statistics on Confidence of Respondents towards FC in Learning Biology

Item no.	*Items*	*N*	*Mean*	*SD*	*Level of perception*
1	I got the ability to self-pace my learning with flipped courses.	26	4.54	0.58	Highest
2	FC gives me greater opportunities to communicate with other students.	26	4.69	0.47	Highest
3	I believe that I can learn the material with FC instruction better than with traditional lecture-based instruction.	26	4.58	0.58	Highest
4	With FC, I feel more prepared for my exam.	26	4.50	0.58	High
5	I feel that mastering learning through FC improved my academic achievement.	26	4.73	0.45	Highest
6	I feel that mastering learning through FC improved my course understanding.	26	4.58	.50	Highest
7	I would like to participate in similar classes in the future.	26	4.35	.98	High
	Overall	26	4.57	.27	Highest

The results of the descriptive analysis on respondents' factors (i.e. confidence) indicated the mean value of 4.57 with the standard deviation of 0.27 (Table 7), indicating that students possess the highest level of perception towards the use of FC as an instructional method. This interpretation was done with reference to the Brown Model (2010) as shown in Table 4.

These findings suggest that the FCA is well-received by students. They feel it enhances self-directed learning, fosters better communication, improves understanding, and boosts academic performance. The high ratings reflect a sense of empowerment and preparedness among learners using this model. Notably, the desire to engage in similar future courses (M = 4.35) implies sustained interest and acceptance of the FC strategy. Overall, the data supports the effectiveness of FC in creating a more engaging and impactful learning experience.

3.5. Factors that Influence Academic Performance of the Students

Table 8 illustrates the correlation between students' interests and academic performance in learning biology in flip classroom-based instructions.

Table 8
Correlation Coefficients of Students' Interest and Academic Performance

Correlations			
		IFC	Scores
IFC	Pearson Correlation	1	.953**
	Sig. (2-tailed)		.001
	N	26	26
Scores	Pearson Correlation	.953**	1
	Sig. (2-tailed)	.001	
	N	26	26

Note. **. Correlation is significant at the .01 level (2-tailed).

A Pearson correlation coefficient was computed to assess the linear relationship between interest as an independent variable and exam score (post-test) as the dependent variable. The findings demonstrate a statistically significant and strong positive correlation between students' IFC (interest and flip classroom) and their academic Scores (r = .953, p < .001). This indicates a clear association wherein higher levels of IFC are consistently linked with higher academic Scores within the sample (N = 26) students.

The correlation coefficient of .953 indicates a very strong positive correlation between students' interest in the FC and their academic performance. This implies that as students' interest in the FC approach increases, their academic scores also tend to increase significantly. The significance level (p = .001) indicates that this relationship is highly statistically significant, and not due to chance.

This finding supports the idea that students who are more engaged or interested in modern, interactive learning methods such as FC are more motivated and better prepared, thus achieving higher academic outcomes. These results suggest that fostering interest in such instructional methods can be an effective strategy for improving student performance.

Table 9 shows the correlation between students' motivation and academic performance in learning biology in flip classroom-based instructions.

Table 9
Correlation Coefficients of Students' Motivation and Academic Performance

Correlations

		MFC	Scores
MFC	Pearson Correlation	1	.963**
	Sig. (2-tailed)		.001
	N	26	26
Scores	Pearson Correlation	.963**	1
	Sig. (2-tailed)	.001	
	N	26	26

Note. **. Correlation is significant at the .01 level (2-tailed).

Table 9 presents the Pearson correlation coefficient, revealing a statistically significant and strong positive correlation between students' Motivation and Flipp Classroom [MFC] and their academic Scores (r = .963, p < .001). This finding indicates a clear and reliable relationship within the studied sample (N=26) students, whereby higher levels of MFC are consistently associated with significantly higher academic achievement.

The findings reveal a very strong and statistically significant positive correlation between students' motivation in a FC and their academic performance. The Pearson correlation coefficient (r = .963) indicates that as students' motivation increases, their academic scores also tend to improve. This high correlation suggests that students who are more engaged and motivated in the FC environment perform better academically. Furthermore, the significance level (p = .001) confirms that this relationship is not due to chance, reinforcing the reliability of the result. These findings highlight the critical role of student motivation in enhancing academic outcomes, particularly within learner-centered and technology-enhanced teaching approaches like the FC model.

Table 10 illustrates the correlation between students' confidence and academic performance in learning biology in flip classroom-based instructions.

Table 10
Correlation Coefficients of Students' Confidence and Academic Performance

Correlations

		CFC	Scores
CFC	Pearson Correlation	1	.934**
	Sig. (2-tailed)		.001
	N	26	26
Scores	Pearson Correlation	.934**	1
	Sig. (2-tailed)	.001	
	N	26	26

Note. **. Correlation is significant at the .01 level (2-tailed).

Table 10 presents the Pearson correlation coefficient, which examines the relationship between students' Confidence and Flip Classroom [CFC] and their academic Scores. The analysis reveals a

statistically significant and strong positive correlation between these two variables (r=.934, p < .001). This robust association indicates that higher levels of CFC are significantly and consistently related to higher academic Scores within the studied sample (N = 26). The obtained probability value is below the established significance level (α = .01), providing strong statistical evidence to support the conclusion that there is a genuine positive relationship between CFC and academic performance in this study.

The findings suggest a strong and statistically significant relationship between student confidence and academic performance. This implies that students who believe in their capabilities and feel more confident are more likely to perform better in their studies. It aligns with motivational theories in education that highlight the role of self-belief and confidence in academic achievement.

Such a high correlation (r = 0.934) is rare and emphasizes the importance of fostering a supportive learning environment where students can build their confidence through feedback, goal-setting, and mastery experiences. This also suggests that interventions aimed at improving confidence could lead to better academic outcomes.

3.6. Findings Based on Qualitative Data

3.6.1. Students' concept of flipped classroom

Analysis of data gathered through semi-structured interviews revealed that the implementation of the FC model in Biology fostered positive perceptions among students regarding both teaching and learning processes. Participants described FC as a student-centered, motivational, and engaging pedagogy that allowed them to take greater responsibility for their learning, ultimately leading to improved academic performance. Students S2, S3, and S4 shared a common understanding of the FC approach, describing it as "a teaching and learning process in which teaching is done outside the classroom during free time, and activities such as homework, group discussions, presentations, and quizzes are done inside the classroom." This description reflects a fundamental shift in the learning paradigm from passive content reception to active knowledge construction and collaboration. The narratives also indicated a strong preference for the continued use of FC in future lessons and a recommendation for its adoption in other subjects. This enthusiasm reflects not only a better understanding of the concept but also a deeper appreciation of its benefits. One participant (S1) vividly recalled their experience, stating:

> Firstly, I will tell you about unforgettable moments in this teaching method, FC. When we use an instructional video clip, we learn more easily by understanding the concept, and if we do not understand, the teacher helps us. Through activities, homework is done in class. In traditional teaching, most of the time, teachers give more homework. But students do not do any work by themselves as they copy from their friends. In FC, we discuss with each other. We also get help from the teacher during the activities in the class.

This reflection clearly highlights how the FC model promotes autonomy, peer learning, and timely support from teachers, factors that are often missing in traditional approaches.

3.6.2. Advantages of the FC Approach

Across all interviews, students consistently emphasized the benefits of the FC approach. One significant theme was the enhancement of learning motivation and engagement. For example, S4 mentioned, "If my teachers use FC, it will help us to enhance our learning." Similarly, S2 noted that FC enables more productive use of free time, as students can watch educational videos and engage with content even during ICT lab sessions, rather than being distracted by non-academic activities. Another strong sentiment was that FC builds student confidence and interest. S1 explained, "FC helps us to increase our interest, motivation, and confidence to take part in a task assigned, which will provide us with a different experience of learning." This was further supported by insights from S2 and S3:

> I would suggest other teachers use this FC because it is interesting, and I have learned many new things. In a traditional class, if a student does not understand while teachers are continuously

> teaching, students can't stop them. In the FC, if students do not understand, they can watch the videos again till they have learned all the concepts and information we are supposed to learn.

S3 added that the interactive nature of FC using instructional videos, PowerPoint presentations, and even Google searches was particularly useful and empowering. The flexibility to learn at one's own pace, combined with collaborative activities in class, provided a supportive and enriched learning experience. Students strongly believed that this method could positively impact their academic performance, especially in examinations.

3.6.3. Challenges faced by students while flipping the classroom

Despite the overall positive feedback, several challenges were identified that may affect the successful implementation of FC. A prominent issue was time management. Most participants (S1, S2, S3, and S4) acknowledged struggling to balance FC activities with other responsibilities. As S1 pointed out, "Time management is important to enhance self-responsibilities and to complete activities in the class, which is very difficult for some of us." This reflects the need for students to adapt to a more self-directed learning style, which may not come naturally to all. In addition to time-related issues, students reported difficulties related to infrastructure and resources. S2 noted, "Another problem that we faced in FC is the lack of required materials such as earphones and enough working computers." S3 expanded on this challenge, mentioning that the computers available were often affected by viruses, further limiting their ability to effectively use digital content. Co-curricular activities after school hours also limited the time students could dedicate to pre-class preparations, further compounding the issue.

These findings underline the importance of providing adequate technological support and training to ensure that all students can fully benefit from the FC approach. Without addressing such barriers, the effectiveness and inclusivity of this otherwise promising teaching model may be compromised.

Overall, the qualitative data affirms that the FC model can be a highly effective and engaging pedagogical strategy for teaching Biology, with students expressing strong support for its broader implementation. The model's ability to promote active learning, increase motivation, and provide individualized support was clearly appreciated. However, to fully realize its potential, schools must address the practical challenges of time management, resource availability, and technological infrastructure. These insights can guide future efforts to scale and refine FC implementation across diverse educational settings.

4. Discussion

There is a significant difference between the scores of EG and CG in terms of their learning abilities during post-test data analysis. The study indicated that EG outperformed CG during post-test indicating the effectiveness of FC as an innovative teaching-learning tool in Biology. For example, the statistical result analysis showed that there was a significant difference ($p=.001$) between the performances of FCG and CG with a mean difference of 1.73 during the post-test. This finding suggests that the FC is a useful teaching tool that can be used by the Biology teachers for enhancing the learning outcomes of students in the Bhutanese classrooms teaching. This finding was consistent with that the findings of Brunsell and Horejsi (2013), and Leo and Puzio (2016) that claimed that 70% of their students increased their standardized test scores, and 80% of the students developed better attitudes when they were taught via the FC. The effectiveness of FC in this study may be attributed to associated features of the tool such as flexibility, self-paced learning, interactive video, and activity-based learning with close interaction with the subject teacher. For example, a study by Brunsell and Horejsi (2013) has claimed that the one way to explain why students outperform in FC is due to its flexibility and provision of ensuring the distribution of learning materials prior to the commencement of actual classroom teaching. All learning materials are distributed to students via offline ICT tools prior to the commencement of the lesson to allow students for the pre-notion concepts generation of the lesson been taught in the class. Such a great

opportunity for the students to have a greater choice of learning platforms being created through FC.

The study revealed that respondents have the highest positive perceptions of using the FC in learning Biology. The findings of a descriptive analysis of respondents' factors (i. e., interest, motivation, and confidence) indicated that respondents possess the highest level of perception towards the use of FC as an instructional method with an overall mean value of 4.51 and a standard deviation of 0.30. Therefore, students liked the FC as instructional strategies to enhance their learning and motivate them to develop a positive attitude towards the learning biology. This finding is consistent with a study by Nouri (2016) at Stockholm University in Sweden and Jurmey et al. (2019) in Shari Higher Secondary school in Bhutan, whose findings reported that students preferred FC over the traditional lecture method. The participants expressed that the instructional hours using FC were more interactive, engaging, interesting, and motivating. The finding also corresponds to the finding of a similar study by Zainuddin and Attaran (2016) that most of the students in Malaysian classrooms have a positive perception towards FC and wanted to continue with it instead of the traditional teaching method. Further, Wilson (2013) and Dorji and Dorji (2022) also concluded that FC has positive impact on students' attitudes and students' academic performance.

The analysis of semi-structured interview data revealed that the implementation of the FC model in Biology classes significantly fostered positive perceptions toward teaching and learning, while also enhancing academic performance. Participants consistently described the FC approach as engaging and motivational, emphasizing that it maximized their learning experiences. Students S2, S3, and S4 provided a unified understanding of FC, describing it as "a teaching and learning process in which teaching is done outside the classroom during free time, and activities such as homework, group discussions, presentations, and quizzes are done inside the classroom." This indicates a clear shift from traditional teacher-centered instruction to a more active, student-centered learning environment.

Moreover, participants expressed a strong desire for the continued use of this teaching approach in the future and recommended its application across other subjects. This enthusiastic endorsement aligns with the findings of Brunsell and Horejsi (2013), and Leo and Puzio (2016), who reported that 70% of their students showed improved standardized test scores, and 80% developed more positive attitudes when taught through the FC model. Consistent with previous research by Leo and Puzio (2016), Nguyen et al. (2016), and Zainuddin and Attaran (2015), this study's findings highlight the benefits of interactive learning facilitated by FC. Participants noted that group discussions and classroom presentations helped them construct and negotiate meaning collaboratively, which contributed to deeper understanding and active engagement. Additionally, the findings echo that of Brunsell and Horejsi (2013) who attributed improved student performance in FC settings to the model's flexibility and its emphasis on pre-class distribution of learning materials. This approach not only prepared students better for in-class activities but also provided them with greater autonomy and access to a variety of learning platforms.

All participants emphasized their expectations that other teachers adopt the FC pedagogy, underscoring the model's perceived effectiveness. This collective viewpoint is supported by previous literature. For example, Akcayir and Akcayir (2018) found that students regarded FC as both informative and motivating, while Jurmey et al. (2019) observed that the method fostered deeper learner engagement and comprehension. Furthermore, studies by Leo and Puzio (2016) and Zainuddin and Attaran (2015) concluded that the FC model promotes active participation, allows for self-paced learning, and cultivates a stronger sense of ownership over the learning process. These collective findings reinforce the idea that FC is not only a progressive and student-centered instructional strategy but also a powerful catalyst for enriching classroom learning.

However, despite these promising outcomes, participants also identified certain challenges encountered during the implementation of FC. A majority (S1, S2, S3, and S4) pointed to time management as a significant difficulty. This concern is consistent with the observations of Chen and Chen (2015) and Kordyban and Kinash (2013), who noted that the shift from teacher-centered

to student-centered paradigms in FC can be hindered by co-curricular demands, increased workloads, and infrastructural limitations. Additionally, issues related to the availability of technological resources were commonly cited. Participants highlighted the lack of access to smartphones, tablets, computers, and reliable internet as barriers to engaging with instructional materials at home. This mirrors the findings of Jurmey et al. (2019), who reported similar challenges at Shari Higher Secondary School in Bhutan, where students lacked adequate devices and internet connectivity to access video lectures and PowerPoint materials outside the classroom.

In conclusion, while the FC model presents significant pedagogical advantages, especially in promoting active and meaningful learning, its successful implementation is contingent upon addressing logistical and infrastructural challenges. The positive reception by students, along with alignment with existing literature, strongly suggests that FC has the potential to transform teaching practices and improve student outcomes when supported by adequate resources and planning.

5. Conclusion

The present study confirmed the use of the FC as an effective teaching-learning approach in teaching biological abstract concepts, particularly the cell division at the secondary level schools in Bhutan. This was mainly attributed to the model designed by Bishop and Verleger (2013), which suggests that flipped learning affords educators a distinctive combination of learning theory: active learning, constructivism/social constructivism, and its components (peer-assisted, collaborative, cooperative, and problem-based learning). In flipped learning, as the students engage in learning at home prior to learning in class, the constructivist definition of student-centred learning is implied. Moreover, learners use their past experiences and knowledge to have a better understanding of the new material, implying an equally socio-constructivist approach. From both the constructivist and socio-constructivist perspectives, learners actively construct knowledge aided by teachers' scaffolding and collaborative/cooperative dialogue with peers.

The better performance of students in FC is evidenced in this study whereby, the FCG performed significantly higher in terms of test scores as compared to CG during the post-test results. It was also noted that the mean and average test scores of the FCG were considerably better than the CG in the post-test result. Therefore, the result of the study manifested a significant improvement in academic achievement and a positive attitude towards Biology learning using FC.

The exposure to the FC developed a more positive attitude in students, which maximized their understanding of the concepts. FC provided opportunities for the students to participate in class, and to articulate their ideas during small group discussions. Students' participation was enhanced while the teacher's dominance in the class was minimized. Hence, the findings of the study revealed that students have a positive attitude towards FC as innovative teaching pedagogy.

The study also revealed that FC promotes individualized learning and better student access to their teacher, even outside the classroom, irrespective of gender. All the students were given equal opportunities to take charge of their own learning through the resources uploaded by the teacher either online or offline in the Information communication Technology laboratory (ICT lab). It is also observed that individual students actively take part in the dynamic teaching-learning process with equal access to adequate time for rich and meaningful learning activities as well as face-to-face interaction with the teacher. Hence, the study concluded that all the students can take part actively in learning Biology using FC, outperforming in their academics.

The study also confirmed that FC is an effective pedagogy to enhance the motivation and learning of students in Biology. Hence, the study recommends Biology teachers as well as other subject teachers access the information to be equipped with the pedagogical knowledge of FC and correspondingly, implement FC in the teaching-learning process. The effective implementation of FC depends upon the teacher's competency in using FC. The study also recommends policymakers such as principals, Dzongkhag Education Officers, and the Teacher Professional Support Division to conduct professional development programs for in-service teachers on FC to provide adequate resources in the school.

Therefore, FC is one of the latest proven 21st-century pedagogy that leverages the academic performance of the learners and promotes child-centred learning, knowledge-based learning, assessment-based learning, and community-based learning. Hence, FC is found to be one of the most effective teaching approaches to have a meaningful teaching-learning process. Moreover, effective implementation of FC will also create lifelong learners and enhance the quality of education.

Acknowledgements: The authors express their sincere gratitude to all participants who generously contributed their time to this study. Special thanks are also extended to the school administrators and students who were involved during the research.

Author contributions: All authors made substantial contributions to the conception, design, and execution of the study, and they fully endorse the conclusions presented.

Data availability: The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declaration of interest: No conflict of interest is declared by author.

Ethics statement: All procedures involving human participants were conducted in accordance with the ethical standards of Ministry of Education, Bhutan. Informed consent was obtained from all individuals prior to their participation in the study.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

Acar, E., & Özler, A. (2024). Mastery learning approach supported by flipped classroom: Does it affect academic achievement and self-regulation skills? *Journal of Pedagogical Sociology and Psychology, 6*(1), 44–57. https://doi.org/10.33902/jpsp.202425567

Akçayır, G., & Akçayır, M. (2018). The flipped classroom: A review of its advantages and challenges. *Computers & Education*, *126*, 334-345. https://doi.org/10.1016/j.compedu.2018.07.021

Aljaraideh, Y. (2019). Students' perception of the flipped classroom: A case study for private universities in Jordan. *Journal of Technology and Science Education, 9*(3), 368–377. https://doi.org/10.3926/jotse.648

Bergmann, J., & Sams, A. (2012). *Flip your classroom: Reach every student in every class every day*. International Society for Technology in Education.

Bishop, J. L., & Verleger, M. A. (2013). *The flipped classroom: A survey of the research* [Paper presentation]. *120th American Society for Engineering Education Annual Conference & Exposition,* Atlanta, Georgia. https://doi.org/10.18260/1-2--22585

Brown, S. (2010). *Likert scale examples for surveys.* Iowa State University Extension.

Brunsell, E., & Horejsi, M. (2013). Flipping your classroom in one "take." *The Science Teacher, 80*(3), 8. https://doi.org/10.2505/4/tst13_080_05_8

Cavanagh, M. (2011). Students' experiences of active engagement through cooperative learning activities in lectures. *Active Learning in Higher Education*, *12*(1), 23-33. https://doi.org/10.1177/1469787410387724

Chen, L., & Chen, T. L. (2015). Students' perspectives of using cooperative learning in a flipped statistics classroom. *Australasian Journal of Educational Technology, 31*(6), 621-640. https://doi.org/10.14742/ajet.1876

Cheng, X. (2024). Peer instruction: assisting active learning in science education. *Science Insights Education Frontiers*, *23*(1), 3633–3635. https://doi.org/10.15354/sief.24.co326

Chen, Y., Wang, Y., Kinshuk, & Chen, N. S. (2014). Is flipped enough? or should we use the flipped model instead? *Computers and Education*, *79*, 16-27. https://doi.org/10.1016/j.compedu.2014.07.004

Creswell, J. W. (2014). *A concise introduction to mixed methods research*. Sage.

Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *American Journal of Physics*, *69*(9), 970-977. https://doi.org/10.1119/1.1374249

Dorji, S., & Dorji, K. (2022). Flipped classroom in teaching biology assessing students' academic achievement in Tang central school, Bumthang district. *Interdisciplinary Journal of Applied and Basic Subjects*, *2*(2), 1-8.

Erbil, D. G. (2020). A review of flipped classroom and cooperative learning method within the context of Vygotsky theory. *Frontiers in Psychology, 11*, Article 1157. https://doi.org/10.3389/fpsyg.2020.01157

Ergene, Ö., & Karaboğaz, Y. (2024). The effect of the flipped classroom model on students' proportional reasoning. *Journal of Pedagogical Research, 8*(1), 294–311. https://doi.org/10.33902/JPR.202425424

Foertsch, J., Moses, G., Strikwerda, J., & Litzkow, M. (2002). Reversing the lecture/homework paradigm using eteach® web-based streaming video software. *Journal of Engineering Education*, *91*(3), 267-274. https://doi.org/10.1002/j.2168-9830.2002.tb00703.x

Formica, S. P., Easley, J. L., & Spraker, M. C. (2010). Transforming common-sense beliefs into Newtonian thinking through Just-In-Time Teaching. *Physical Review Special Topics-Physics Education Research*, *6*(2), 106. https://doi.org/10.1103/PhysRevSTPER.6.020106

Johnston, N., & Karafotias, T. (2016). Flipping the classroom to meet the diverse learning needs of library and information studies (LIS) students. *Journal of Education for Library & Information Science*, *57*(3), 226-238. https://doi.org/10.3138/jelis.57.3.226

Jurmey, P., Lham, T., Lhaden, K., Pema, T., & Rai, B. B. (2022). Flipped classroom: Prospect in freeing up classroom instructional hours and students' attitude towards flipped classroom strategy. *Educational Innovation and Practice, 5*(1), 1–16. https://doi.org/10.17102/5.1.eip.2022

Kim, M. K., Kim, S. M., Khera, O., & Getman, J. (2014). The experience of three flipped classrooms in an urban university: An exploration of design principles. *Internet and Higher Education*, *22*, 37–50. https://doi.org/10.1016/j.iheduc.2014.04.003

King, A. (2016). From sage on the stage to guide on the side. *College teaching*, *41*(1), 30-35. https://doi.org/10.1080/87567555.1993.9926781

Kordyban, R., & Kinash, S. (2013). No more flying on auto pilot: The flipped classroom. *Education Technology Solutions*, *56*, 54-56.

Lage, M., Platt, G., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *Journal of Economic Education, 31*(1), 30-43. https://doi.org/10.1080/00220480009596759

Leo, J., & Puzio, K. (2016). Flipped instruction in a high school science classroom. *Journal of Science Education and Technology*, *25*(5), 775–781. https://doi.org/10.1007/s10956-016-9634-4

Lo, C. K., & Hew, K. F. (2017). A critical review of flipped classroom challenges in K-12 education: Possible solutions and recommendations for future research. *Research and Practice in Technology Enhanced Learning*, *12*(1), 4. https://doi.org/10.1186/s41039-016-0044-2

Luttenberger, S., Macher, D., Maidl, V., Rominger, C., Aydin, N., & Paechter, M. (2018). Different patterns of university students' integration of lecture podcasts, learning materials, and lecture attendance in a psychology course. *Education and Information Technologies*, *23*(1), 165–178. https://doi.org/10.1007/s10639-017-9592-3

Nguyen, B., Yu, X., Japutra, A., & Chen, C.-H. S. (2016). Reverse teaching: Exploring student perceptions of "flip teaching". *Active Learning in Higher Education*, *17*(1),51–61. https://doi.org/10.1177/1469787415616727

Nouri, J. (2016). The flipped classroom: for active, effective and increased learning–especially for low achievers. *International Journal of Educational Technology in Higher Education*, *13*, 1-10. https://doi.org/10.1186/s41239-016-0032-z

Overmyer, G. R. (2014). *The flipped classroom model for college algebra: Effects on student achievement* [Unpublished doctoral dissertation]. Colorado State University, Colorado.

Thompson, C. (2011). How Khan Academy is changing the rules of education. *Wired Magazine*, *126*, 1-5.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wangdi, T. (2016). Teachers introduced to transformative pedagogy. *Kuensel – Bhutan's National Newspaper.* https://kuenselonline.com/

Wilson, S. G. (2013). The flipped class: A method to address the challenges of an undergraduate statistics course. *Teaching of Psychology, 40*(3), 193–199. https://doi.org/10.1177/0098628313487461

Zainuddin, Z., & Attaran, M. (2015). Malaysian students' perceptions of flipped classroom: *A* case study. *Innovations in Education and Teaching International, 53*(6), 660-670. https://doi.org/10.1080/14703297.2015.1102079