



Understanding nursing students' perception and performance during a pharmacology course taught in a flipped classroom setting: A pilot study

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Abstract: -

Introduction: Emerging education methods offer significant advantages over traditional teaching approaches, supported by students' feedback, which serves as a foundation for their development and advancement in the ongoing educational journey.

Purpose: To examine nursing students' opinions about a pharmacology course taught in a flipped classroom (FC) setting at King Abdulaziz University and its impact on their learning outcomes when compared to the traditional classroom model.

Design & Methods: The current study drew on a locally administered questionnaire of twenty closed-ended Likert items to examine students' opinions about the flipped classroom approach adopted for the delivery of a pharmacology course to third-year nursing students. The students were randomly divided into a control group (traditional class, N=55) and an experimental group (flipped class, N=61). A post-test was conducted for both groups to compare students' performance and learning outcomes.

Results: Scoring was performed in five areas: instructor, time adequacy, learning materials, learning environment, and understanding. A statistically insignificant difference ($P=0.07$) was noted by comparing the mean scores of a post-test assessment of the two groups.

Conclusion: This study demonstrates that the use of the flipped classroom approach for teaching pharmacology lessons meets with some students' satisfaction. This proposed study adds evidence to the current literature that, whenever the conditions of FC are properly set, the flipped classroom will have the potential to increase the range of student learning experiences with no detriment to outcomes.

Keywords: Flipped classroom, Traditional classroom, Likert item, Quantitative analysis.

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Introduction

The essential part of teaching is to make learning effective (Haghani, Rezaei et al. 2016). Few studies have shown that critical skills such as thinking, writing, and analysis do not develop in the majority of students during the process of learning (Whiffin and Hasselder 2013, Johan 2024, Mujiono, Weganofa et al. 2024, Penelitan, Ipa et al. 2024). In some studies, the idea of traditional classroom teaching is blamed for such outcomes (Lattuca, Bergom et al. 2014, Laursen, Hassi et al. 2014, Rico and Ertmer 2015). Therefore, reforms are needed in the teaching system. One such reform method is the flipped classroom. The term “flipped classroom” was described in the year 2000 as the “events that have traditionally taken place inside the classroom now take place outside the classroom and vice versa” (Lage, Platt et al. 2000, Northrup and Burke 2015, Triantafyllou, Timcenko et al. 2016, Algayres and Triantafyllou 2019). In this model, content that was previously delivered to the students in the classroom setting, such as face-to-face lectures, can be provided to students before the actual class.

The lecture material is provided through audio and/or recorded material, media, or other written material (Herreid and Schiller 2013, Presti 2016). The class time is then used to engage students in group problem-solving, case studies, discussion, and experiments, all in the presence of the instructor (Herreid and Schiller 2013, Presti 2016). Flipped classroom model is based on instructional strategy and a type of blended learning that alters the traditional learning environment, and combines both formal (traditional classroom) and non-formal (online courses) methodologies (Liu, Ripley et al. 2016). The term flipping comes from the idea of swapping homework for classwork (Ash 2012).

In a flipped classroom, students are required to read or watch lecture videos before the face-to-face class time. Subsequently, class time is used for discussions, problem-solving, role plays, case studies, or other types of learning that enable the students to use the acquired knowledge. This may help to increase students' degree of attention, interest, and passion during the class (Kurt 2018).

Tune et al. (2013) found that flipped learners tend to show better preparation for lesson content. Tune, Sturek et al. (2013), Davies, Dean et al. (2013), Butt (2014), and Kazanidis, Pellas et al. (2018) found that these learners are also typically more entertained, engaged, and enthused within such a setup (Davies, Dean et al. 2013, Butt 2014, Kazanidis, Pellas et al. 2018). In some studies, it was also found that flipped learners typically earn higher grades in exams (Tune, Sturek et al. 2013, Findlay-Thompson and Mombourquette 2014, Al-Zahrani 2015, El-Banna, Whitlow et al. 2017, Thai, De Wever et al. 2017, Chun and Heo 2018, Kazanidis, Pellas et al. 2018). This could be explained as the students have more preparation time before the class and perform activities and discussions with their peers in the class. Likely, the student exposure to the learning material is increased before the class, therefore, students are expected to get a better outcome. Although the evidence is not entirely substantial, it does indicate support for the process.

Thus, in the current study, we investigated the impact of our pilot study on nursing students to have a general idea about reflecting the concept of the flipped class. The findings of the present study would be helpful in further investigation of future research.

Design and Methods

Quasi-experimental design

This study is quasi-experimental and consists of a post-test-only control group design (Campbell and Stanley 1963). It was designed with a post-test to measure nursing students' learning outcomes and investigate their opinions after exposure to the flipped classroom setting during a pharmacology course. This research design was adopted because it grants determining students' learning outcomes and overall impact on them, if any, in the flipped class setting compared to the traditional class.

Study setting

This proposed research took place at the Faculty of Nursing at KAU, located in the east of Jeddah city, in the Kingdom of Saudi Arabia. The study took place near the end of the second semester in the spring of the 2017-2018 academic year. The classroom in this study has an LCD projector, an interactive whiteboard, a sound system, and a main disk computer with an internet connection for the instructor's use only.

Participants

The current study included (No = 116) third-year female nursing students systemically enrolled in the pharmacology (PHAN-312) course during the academic year 2017-2018. PHAN-312 course provides students with grade 6 pharmacology in nursing graduation requirements, included in the Bachelor of Nursing program. It is a two-credit-hour course composed of 15 topics taught over 15 weeks. However, a lecture (2 hours) about general anesthesia was shortlisted to be taught in a flipped class setting. The students (No = 116) were systematically divided into two sections: A and B. Section (A) which included (No = 55) students assigned randomly as the control group receiving the topic in a traditional class setting. Section (B) included (No = 61) students assigned as the experimental group receiving the same topic in a flipped class setting.

Instructional strategies in traditional and flipped classrooms

The teaching strategies of both classrooms are summarized in Tables 1 and 2 of the supplementary section.

Satisfaction questionnaire

In this study, closed-ended questions were used to collect quantitative data. The designed questionnaire (Supplementary-Questionnaire-1) included the following main topics: demographic information (Age, experiences with electronic resources, and type of school education), learning materials, classroom arrangement, scheduled time, group activities, pre-class time, and specific questions about flipped class effects. The Department of Medical Education revised the survey questions to confirm their relevance to the research questions. After the questionnaire was completed, each item was analyzed separately, and the responses were summed up to create a score for a group of items. Data scaled from 1 to 5 was then analyzed using the IBM Statistical Package of Social Sciences (IBM SPSS Statistics V 26).

Post-test

The post-test assessment was performed to investigate the effect of the flipped class strategy on learning outcomes and to compare them with those of the traditional class. The test included 23

multiple-choice questions constructed from the mutual content of the pharmacology lesson (Supplementary Questionnaire 2). Each question was mapped with the lesson objectives to ensure assessment consistency. Further, the test questions were shared with other faculty peers for review.

Ethical Considerations

The study proposal was approved by the Unit of Biomedical Ethics, Faculty of Medicine, King Abdulaziz University, KSA (Reference No-674-19).

Statistical analysis for closed-ended questions of the questionnaire, rated on a Likert scale

Median and mode were the two nonparametric procedures used to analyze the data. With the Statistical Package of Social Science (SPSS) software version 26, the median was calculated (all the scores were arranged in order, and the middle score was chosen). If there were an even number of scores in the distribution, the median was determined by taking the mean of the two middle scores. However, the mode is the score appearing most often within a distribution (Cohen and Swerdlik 2005).

Statistical analysis of the post-test assessment

To assess the differences in students' learning between flipped and traditional instructions, we examined the post-test scores of both groups. To test the significance of exam grade differences between flipped class and traditional class, an independent sample *t*-test was used to compare the mean scores of the post-test assessment between the two groups. The level of significance was established at an alpha equal to 0.05.

Questionnaire analysis

The five factors for quantitative analysis were presented as a series of Likert scale items. There were at least two items that addressed each theme. The survey featured 20 closed-ended questions. After establishing the validity and reliability of the questionnaire, the data was used to address the study questions. Descriptive statistics were used to summarize the participants' characteristics, students' opinions of the different aspects of the flipped teaching sessions, and students' scores in the post-test evaluation.

Results

The main purpose of this study was to evaluate students' opinions about the flipped classroom strategy and whether it has a positive impact on the quality of learning as compared to the traditional lecture-based teaching of KAU third-year female nursing students during their pharmacology course.

The quantitative data provided an overview of the general opinion of the students surveyed. The results were categorized based on five different factors: instructor, flipped classroom time, learning materials, learning environment, and student understanding. Each factor includes a group of Likert items.

Survey factors:

Instructor performance factor

The main aim of this factor was to analyze students' satisfaction with the instructor in terms of providing learning materials before class, student engagement, and providing help to students with clarifications where difficulties existed. Three items in the questionnaire addressed students' opinions about the instructors' performance in the flipped classroom (Supplementary-Questionnaire-1). These are items 1, 17, and 18. The first item stated: "Learning materials (video and handout) were available before the flipped classroom (FC) activity (Likert item 1)". These items elicited the strongest response from students for this factor. The results showed that out of 61 surveyed students, 47 (77%) strongly agreed that the learning materials were available before the flipped classroom activity. Furthermore, 12(19.7%) students agreed with the availability of the learning materials, whereas only two (3.3%) students were unsure. It should be noted that no student's disagreement with this item was registered. Hence, these results clearly show that most students were satisfied with the availability of the learning materials before the class. The median and mode scores support a strong agreement among the respondents (Figure 1).

Next, the factor "Instructor was able to engage students in the flipped classroom (FC) activity" (Likert item 17) was analyzed. It was observed that 25(41%) students strongly agreed, 18(29.5%) students agreed that the instructor was engaging in the classroom, 10(16.4%) were unsure, and the same result four (6.6%) students were recorded for both students who disagreed and strongly disagreed. The median and mode scores of this statement demonstrated agreement between the students (Figure 1). It resulted in a medium agreement response rate from the students for this factor and indicated more engagement would be required from the instructor in the future if the flipped classroom strategy is used.

Finally, the factor "The instructor was able to provide clarification on the difficult concepts during the flipped classroom" (Likert item 18) was analyzed. Results showed that 22(36.1%) students strongly agreed with the statement and 16(26.2%) students agreed. Further, for this factor, 14(23%) students were unsure about their opinion, and this was noted as the highest rate of neutral responses among the students regarding the instructor factor. It is also noted that there was disagreement by 6(9.8%) students and a strong disagreement by 3(4.9%) students among the sample over this item. Again, the low response from the students against this item indicated that more effort is required from the instructor to clarify difficult concepts to the students in a flipped class. Additionally, the success of the FC setup in response to the above item also depended on how intensively students studied the content of the lecture (Figure 1). In conclusion, the mean of the overall instructor satisfaction factor is 4.15/5.00 per scale, which reflects a high level of satisfaction. Moreover, the new satisfaction variable declares that 86.9% of respondents are satisfied with the instructor.

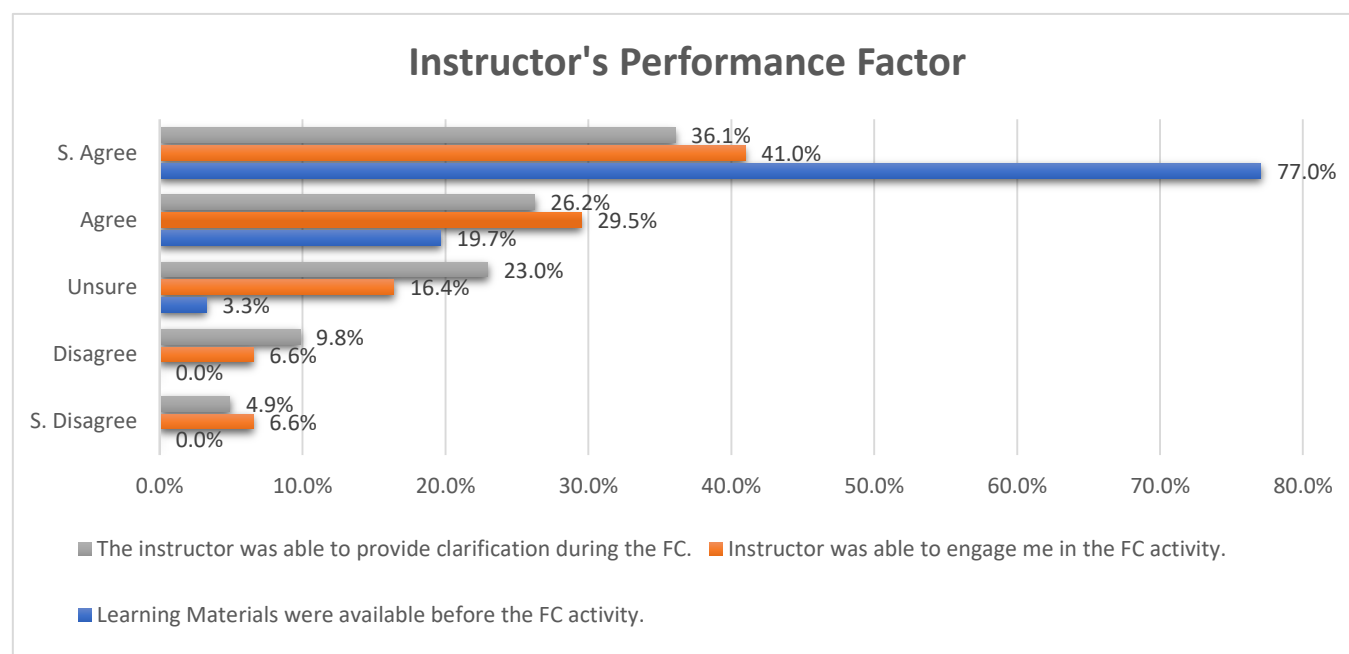


Figure 1 Students' Attitudes Regarding the Instructor's Performance Factor

- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Strongly Agree
- Median: Strongly Agree, Mode: Strongly Agree

The mean of the overall instructor satisfaction factor is 4.15/5.00 per scale.

Time factor

The main aim of this factor was to analyze the students' satisfaction with the sufficiency of pre-class time given to the students to understand the uploaded materials before the FC, personal study time, and in-class time scheduled for the flipped classroom session. There were three items in the questionnaire; 2, 5, and 7, which gathered students' opinions about the time factor in the flipped class. The second factor stated that adequate time was provided to spend on learning before the flipped classroom activity (Likert item 2). Results showed that the strongest response of the students was to the time factor as almost more than half of the students 31(50.8%) strongly agreed that they were provided with adequate time to spend on learning before the FC, while 14(23%) of the students agreed, and only six (9.8%) students disagreed (Figure 2). The median and mode scores also confirmed that most students strongly agreed. Next, the students were asked whether

personal study time enhanced their self-learning ability (Likert item 5). The overall response to this item particularly was (60). What stands out in (Figure 2) is that equal numbers of students 22(36.7%) either strongly agreed or agreed. In contrast, 12(19.7%) students were unsure, three students (5%) strongly disagreed and only one student (1.7%) disagreed. The median and mode scores confirm that students largely agreed. Finally, the students were asked whether the scheduled time for the FC session was adequate (Likert item 7). The result showed that 28(45.9%) students strongly agreed, and 23(37.7%) students agreed with this item. In contrast, only two (3.3%) students disagreed, and seven (11.5%) students were unsure about their responses. In conclusion, the mean of the overall time satisfaction factor is 4.13/5.00, reflecting a high level of satisfaction. Moreover, the new satisfaction variable declares that 88.5% of respondents are satisfied with the time factor.

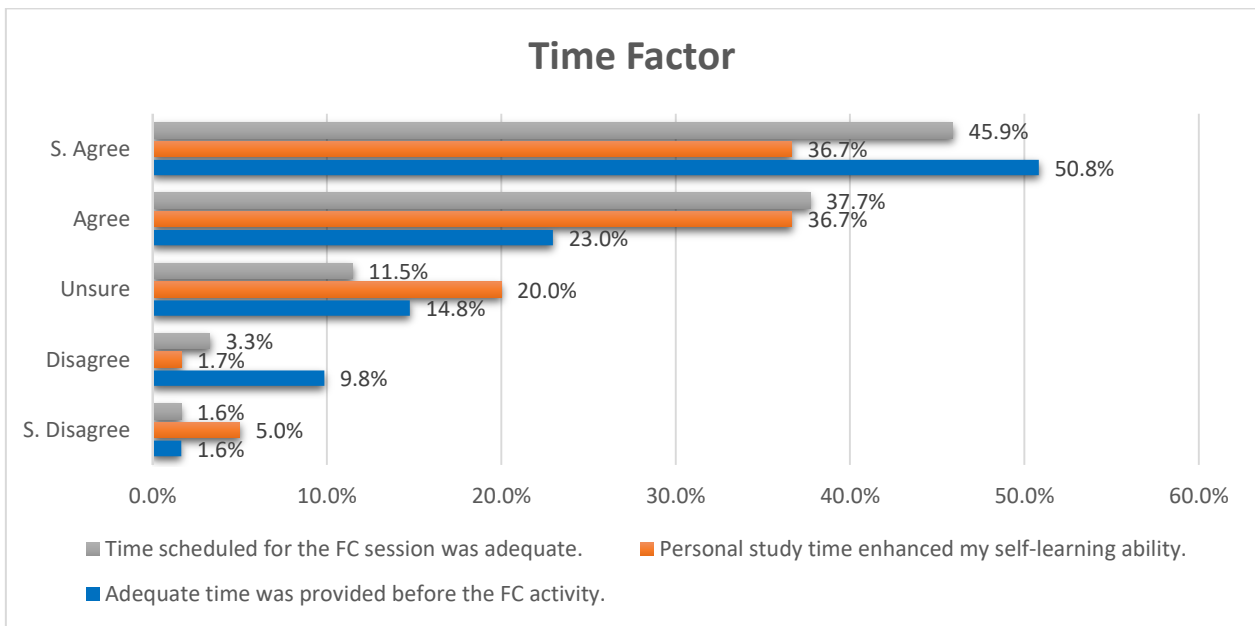


Figure 2 Students' Attitudes Regarding the Time Factor

- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Agree
- Median: Strongly Agree, Mode: Strongly Agree

The mean of the overall instructor satisfaction factor is 4.13/5.00 per scale.

Learning Material Factor

In this factor, the students' satisfaction with the learning material provided to them was analyzed. Likert item 3 states that learning materials were relevant to the flipped classroom activity. The results from this item were overwhelmingly positive as 37(60.7%) students strongly agreed, 21(34.4%) students agreed, and only three (4.9%) students were unsure. It should be noted that none of the students disagreed with this item. The median and mode scores also confirmed the agreement of the students. Next, students were

asked to give their opinion on whether the learning material provided to them was user-friendly (Likert item 4). Among all students, 28(45.9%) students strongly agreed, 26(42.6%) students agreed, five (8.2%) were unsure and two (3.3%) disagreed. The median and mode scores confirmed the students' general agreement that the learning materials were user-friendly. In conclusion, the mean score for the overall learning material satisfaction factor is 4.43/5.00, reflecting a high level of satisfaction. The overall student satisfaction regarding the study material was very high (95.1%) (Figure 3).

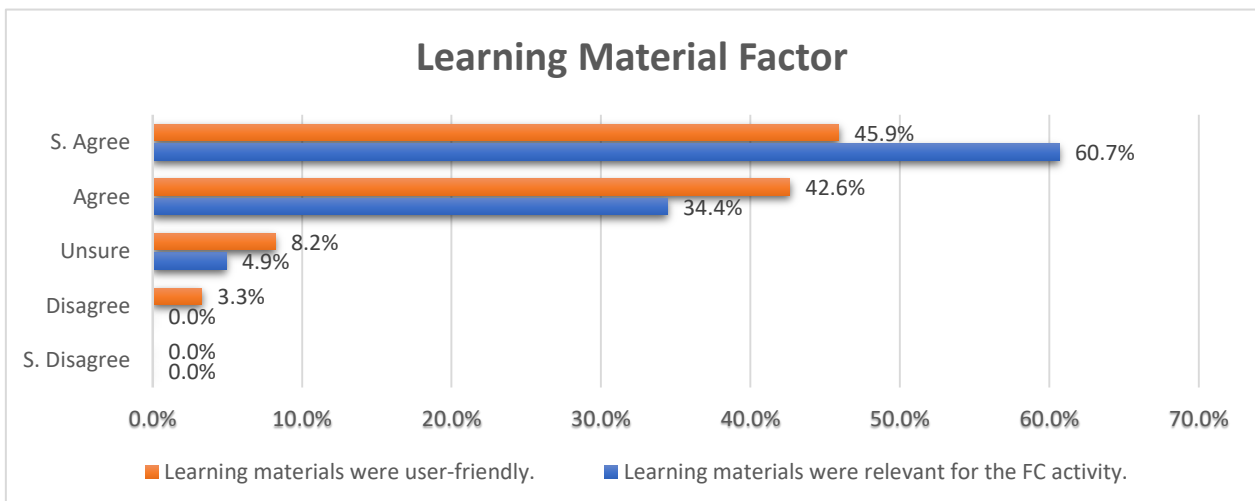


Figure 3 Students' Attitudes Regarding the Learning Material Factor

- Median: Agree, Mode: Strongly Agree
- Median: Strongly Agree, Mode: Strongly Agree

The mean of the overall instructor satisfaction factor is 4.43/5.00 per scale.

Learning Environment Factor

This factor examines the students' satisfaction with the FC learning environment. The satisfaction of classroom arrangements, activity sessions, motivation, and engagement was assessed, which were covered in Likert items 6, 8, 19, and 20, respectively. Likert item 6 states: "Classroom arrangements (positioning of the chairs for a group activity, audio-visual facilities, etc.) were conducive to flipped classroom activity". As shown in (Figure 4), 19(31.1%) students agreed, 18(29.5%) students strongly agreed, 11(18%) students were unsure, seven (11.5%) students disagreed, and six (9.8%) students strongly disagreed. It was observed that there is a notable student response all over the scale to this important item. Next, Likert item 8 which states: "Group activities conducted during FC sessions were organized" was examined. Again, 45(73.8%) of the students in the sample either agreed or strongly agreed with this item compared to 8(13.1%) who disagreed and strongly disagreed, and 8(13.1%) who were unsure. The median and the mode scores also confirmed that the students largely agreed that group activities were satisfactorily conducted. Next, the students were asked whether the learning environment during the

flipped classroom motivated them as learners (Likert item 19). Upon analysis of the results, it was observed that 23(37.7%) students agreed, and 20(32.8%) students strongly agreed with it. Five (8.2%) students disagreed, and three (4.9%) students strongly disagreed. The median and the mode score corroborate the findings that students largely agreed that they were motivated. Finally, the students were asked whether the flipped classroom (FC) is more engaging than the traditional classroom (Likert item 20). It was highly encouraging to note that almost 48(78.7%) of the participants agreed or strongly agreed that flipped classroom was more engaging than traditional classroom instruction. 10(16.4%) of the participants were unsure and three (4.9%) students disagreed or strongly disagreed with this item. The median and mode scores also indicate that the students strongly agreed that the flipped classroom was more engaging. In conclusion, the mean of the overall learning environment satisfaction factor is 3.89, reflecting a high level of satisfaction. Moreover, the new satisfaction variable declares that 78.7% of respondents were satisfied with the learning environment (Figure 4).

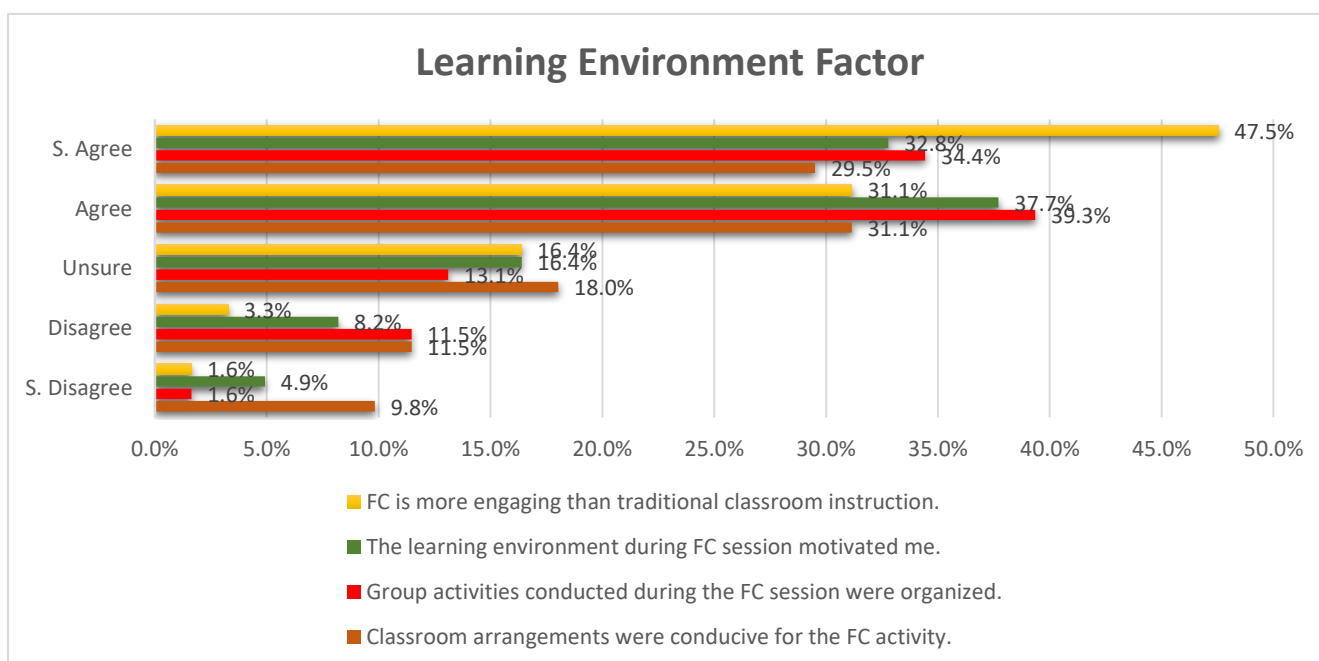


Figure 4 Students' Attitudes Regarding the Learning Environment Factor

- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Agree
- Median: Agree, Mode: Agree
- Median: Agree, Mode: Agree

The mean of the overall learning environment factor is 3.89/5.00 per scale.

Understanding factor

(Figure 5) below summarizes the last factor of this study. The students' opinions regarding the overall understanding of the flipped classroom and how it helps to improve their performance were analyzed. The eight items that addressed these aspects in the questionnaire were items number 9, 10, 11, 12, 13, 14, 15, and 16. Likert item 9 stated: "Flipped classroom method provided an interesting learning experience for the students". 28(46.7%) of the students strongly agreed, while 19(31.7%) students agreed with this opinion. Only three (5.0%) students disagreed, and 10(16.7%) students were not sure. The median and mode scores also concur

with the findings of strong agreement. Further, the students were asked if the flipped classroom was informative and useful (Likert item 10). 33(54.1%) students strongly agreed, and 18 (29.5%) agreed, making a total percentage of (83.6%) of students in agreement that the flipped classroom (FC) was informative and useful. Only two (3.2%) students disagreed, while eight (13.1%) students were unsure whether the flipped classroom (FC) was informative and useful. The median and mode scores also demonstrate strong agreement. Next, Likert item 11: "Flipped classroom (FC) method improved my understanding and application of the topic" was analyzed. As shown in, 22(36.1%) students strongly agreed, and 21(34.4%) agreed. 14(23%) students

were unsure about their responses. The fourth item of this factor asked whether the flipped classroom (FC) inspired the students to pursue further learning of the topic or subject (Likert item 12). In response, 24(40%) students strongly agreed, and 13(21.3%) students agreed. As was the case of the previous item, 17(27.9%) students showed an unsure response while five (8.3%) students disagreed with this item. The students were then asked if flipped classroom method would positively affect their attendance rate to better learn the topic (Likert item 13). The results show that 21(34.4%) students strongly agreed, 16(26.2%) students agreed, whereas four (6.6%) students and three (4.9%) students strongly disagreed and disagreed, respectively. Interestingly, nearly one-third (27.9%) of the students were unsure. The median and mode scores (21) show that students largely agreed. The next important point in this factor is Likert item 14: "Flipped classroom method may improve my performance in the exams". The majority of the students agreed that the flipped classroom (FC) sessions would assist them in improving their performance in the exams;

20(32.8%) students agreed, while 17(27.9%) students strongly agreed. A total of nine (14.7%) students either disagreed or strongly disagreed. A striking feature again for this factor was that a notable percentage of students (24.6%) were unsure. Next, students' opinion was sought on the aspect of whether the flipped classroom (FC) method suited my learning style (Likert item 15). Here, 22(36.1%) students agreed, while 19(31.7%) students strongly agreed. Seven (11.7%) students disagreed, and two (3.3%) students had shown strong disagreement. Finally, Likert item 16, which stated: "More lectures should be conducted by flipped classroom method" was analyzed. Interestingly, most of the students 39(64%) wanted more lectures to be conducted through the FC method. 22(36.1%) students strongly agreed, and 17(27.9%) students agreed. Only four (6.6%) students disagreed, five (8.2%) students strongly disagreed, and 13(21.3%) students were unsure. In conclusion, relatively high student satisfaction (83.6%) was observed in the understanding factor of FC arrangement.

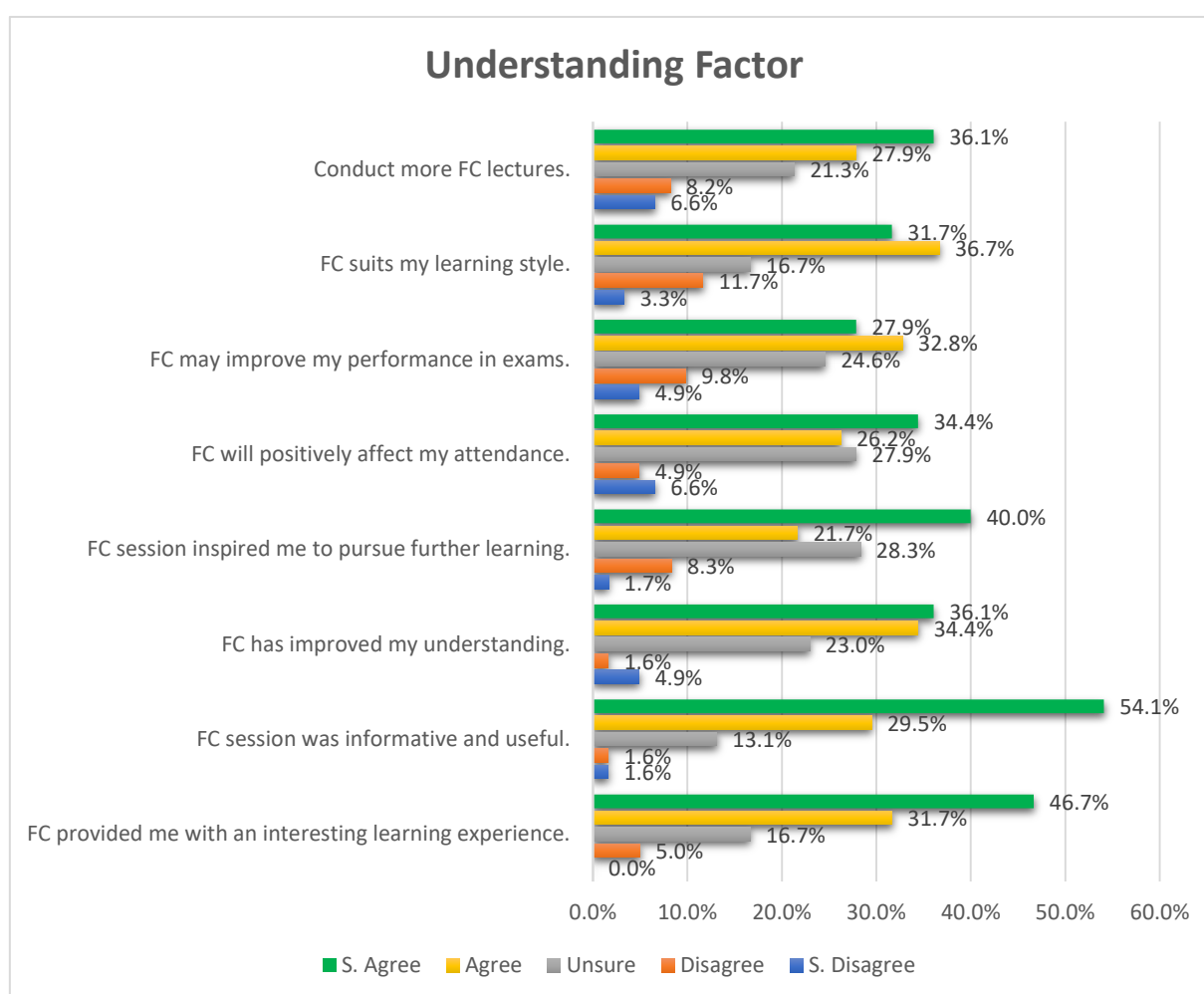


Figure 5 Students' Attitudes Regarding the Understanding Factor

- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Agree
- Median: Agree, Mode: Agree
- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Strongly Agree
- Median: Agree, Mode: Strongly Agree
- Median: Strongly Agree, Mode: Strongly Agree
- Median: Agree, Mode: Strongly Agree

High student satisfaction (83.6%) was observed in the Understanding Factor..

Post-test analysis

The post-test assessment aimed to investigate the differences in students’ learning gains between the flipped and traditional classes by comparing the post-test scores of the two groups. In the data analysis of the post-test scores, a t-test was used to test the significance of exam grade differences between flipped and traditional classes. The independent samples t-test procedure compares the mean differences between the two groups. The total

score of the conducted post-test was 15 marks. The mean score of the flipped class was 11.68 compared to the mean score of the traditional class, which was 12.17 (**Table 1**). However, by applying the independent sample t-test, there was no significant difference ($P = 0.07$) between FC and traditional class post-test scores at a 95% confidence interval provided that the calculated range of students’ scores for the flipped class was (6.50) and for the traditional class was (5.85) (**Table 2 & Table 3**).

Table 1: Descriptive statistics of flipped class (N=61) and traditional class (N=55). The actual exam grade was 15.

Class type	Number	Mean	Std. Deviation	Std. Error Mean
Flipped classroom	61	11.68	1.543	0.198
Traditional classroom	55	12.17	1.361	0.184

Table 2: 95% confidence interval for mean with the calculated range for the flipped class group.

Exam Grade (15)	Mean		11.6787
	95% Confidence Interval for Mean	Lower Bound	11.2836
		Upper Bound	12.0738
	Minimum		7.80
	Maximum		14.30
	Range		6.50

Table 3: 95% confidence interval for mean with the calculated range for the traditional class group.

Exam Grade (15)	Mean		12.1727
	95% Confidence Interval for Mean	Lower Bound	11.8047
		Upper Bound	12.5408
	Minimum		9.10
	Maximum		14.95
	Range		5.85

Discussion

The introduction of new methods of delivering information to students like the flipped classroom will make the sessions more interactive, and the students will gain the maximum benefit (Berdiyorova 2021, Köpeczi-Bócz 2024, Zeng 2024). This study aims to compare learning outcomes when using the classical teaching method (lecture-based) to the flipped class type. This was answered by the student’s questionnaire designed particularly for this purpose.

There are few studies on flipped classrooms with respect to higher education, and only a minority of them studied their role in nursing education (Schlairet, Green et al. 2014, Yensen 2014, Mikkelsen 2015, Njie-Carr, Ludeman et al. 2017).

The closed-ended questions of the questionnaire were analyzed to investigate students’ views about the flipped class strategy. Furthermore, post-test assessment results for both groups were analyzed to examine any significant differences in the learning outcomes between the two groups. The results of this pilot study showed that the nursing students were satisfied with the use of flipped classroom strategy as a new approach. The five pillars of this questionnaire were instructor, time factor, learning materials, learning environment, and understanding. Subsequent analyses showed that the students were generally satisfied with the suggestions provided to improve teacher skills for conducting an interactive class, resolving schedule conflicts, and using classroom time more effectively and creatively. Hence, it should be noted that students’ response to these closed-ended questions was related to the specific circumstances of this pilot study of flipped class approach. These circumstances included teacher skills for

conducting an interactive teaching class, learning environment, general pre-flipped class arrangements, and timing of flipped class implementation.

Regarding the effect on learning outcomes and analysis of post-test scores, the study showed a statistically insignificant difference between the two classes. This finding is in line with a previous study reporting that by decreasing traditional classroom activities and increasing online videos, student performance was the same (Baepler, Walker et al. 2014).

However, this contradicts the findings of a previous study which reported that the flipped classroom methods have a significant improvement effect on nursing students' performances compared to classical teaching (Entezari and Javdan 2016, Tan, Yue et al. 2017).

These results require further research into the effects of multiple FC sessions. Adopting the flipped classroom model constitutes a role change for the instructors who give up their front-of-the-class position in favor of a more collaborative and cooperative contribution to the teaching process (Lai and Hwang 2016). The students also now possess the necessary digital skills to learn outside the classroom, and these skills can be used in a planned way to support their learning. Advances in technology have made this possible in the flipped classroom by making fundamental facts and knowledge available for student review before actual class time (Rahmat, Anuar et al. 2023, Kuswidayani, Soepriyanto et al. 2024, Saadi 2024).

One can argue that the inclusion of the FC enriches some students' learning experience, while it is unlikely to be objected to by others. However, successful implementation requires careful consideration, taking into account the students' level and best practices for flipped classroom design (Hashem 2023, Larson and Linnell 2023, Thulasidas 2024). The flipped classroom has no negative impact on the academic achievement of students (Abdel-Wahab Afifi Araby, Mansour Abdel Azeem Barak et al. 2024, Kadiri 2024, Rajhans and Saroh 2024). Further, more research is required to investigate the effect of multiple best-practiced flipped classes conducted in context. In conclusion, the inclusion of FC enriches students' learning experience and, as such, may be a worthwhile addition to the curriculum, considering students' suggestions as a value-added advantage.

A limitation of this study is that it is conducted on one subject, and to draw a good conclusion, this can be made by applying it to more subjects. Students' subject preferences could also be a confounding factor.

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Disclosure of interest

The authors report no conflict of interest.

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