International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

https://gssrr.org/index.php/JournalOfBasicAndApplied/index

Exploring the Classroom Environment in a Grade 7 Flipped Science Class in the Philippines

Aprhodite M. Macale[a*], Ann Jelin G. Angeles[b], Ellen Ann A. Diolata[c], May Ann B. Lapitan[d], Rina A. Mabilangan[e]

[a,b,c,d,e]*University of the Philippines Rural High School*

[a]*Email: ammacale@up.edu.ph*, [b]*Email: agangeles4@up.edu.ph*, [c] *Email: eaadraneda@up.edu.ph*

[d]*Email: mblapitan@up.edu.ph*, [e]*Email: ramabilangan@up.edu.ph*

Abstract

The limitations of the traditional lecture method of teaching motivated teachers to transform education based on how students learn and the kind of environment they are in by integrating technology into the teaching and learning process. Using a descriptive research design, this study compared the characteristics of the classroom in a conventional classroom (CC) and a flipped classroom (FC) setting. Two intact classes of Grade 7 students from a public high school in Sta. Cruz, Laguna, participated in this study. The FC strategy investigated in this study encouraged learners to learn at their own pace by coming to class prepared for active learning activities. Class activities were observed, and classroom observation scores for each setting were gathered and analyzed. Statistical analysis showed that there was sufficient evidence to say that the classroom environment on class observation days 8, 9, 10, 13, and 14 (p-values of 0.0152, 0.0012, <0.0001, 0.0006, and <0.0001, respectively) were significantly different for the two classroom set-ups with the FC set-up showing a better classroom environment than the CC in terms of productivity, quality of feedback, language modeling, instructional learning format, and concept development. During the first four days of FC implementation, there was a lack of a pleasant atmosphere, effective behavior management, high-quality feedback, high levels of productivity, and the creation of new concepts. In addition, the action undertaken by the teacher/researcher to address the challenges in developing a positive classroom environment in the FC was discussed in this study.

Keywords: classroom environment; flipped classroom; technology integration.

Received: 7/25/2023
Accepted: 8/30/2023
Published: 9/2/2023

---

* Corresponding author.

1. Introduction

1.1 Background of the study

In a typical classroom environment, teachers are often seen lecturing or giving out handouts as the students take notes and memorize lessons. At the end of a unit or chapter, assessment activities such as tests were implemented to determine what students had learned. However, this practice has become a thing of the past, where education is just a transfer of information, especially in the sciences [20, 28].

While the traditional learning environment may be deemed effective in facilitating learning, other innovative learning modalities have been endorsed to provide richer learning experiences. For instance, the availability of handheld gadgets, personal computers, and laptops has opened doors for the use of technology in education. The generation of learners today, often called "Millennials," "Gen Ys," or the "Net Generation," have been born into an open society where content and information can be accessed immediately, anytime, and anywhere [24]. With the kind of environment they are born into, they prefer hands-on experiential activities. In addition, many prefer to work and interact with peers. In the Philippines, the inclusion of technology in the K–12 curriculum aims to achieve its objective of holistic development of the students through mastery of competencies and skills relevant to employment [8]. The enhanced K–12 curriculum is expected to be technologically and globally attuned.

1.2. Flipped Classroom

Flipped classrooms, which blend technology into the daily learning of students, are an emerging trend in science education [16]. The use of flipped classrooms has provided students with the opportunity to arrive at school well-prepared. [13, 15]. When both the teacher and, most importantly, the students arrive at class prepared, there is a greater potential for learning to take place [13]. When they are well prepared, they participate in classroom activities with greater enthusiasm and have greater confidence in their ability to assist one another. This model of teaching relies heavily on students learning on their own [14, 24].

In a flipped classroom, students have time to assess their own understanding and monitor their own thinking through metacognition. Moreover, time inside the classroom is devoted to cognitive activities that lead to mastery. Students are expected to apply, analyze, synthesize, and evaluate the ideas that they have learned outside the class using the information and comprehension that they have gained as a result of using this strategy [23].

Moreover, flipped instruction strengthens teacher and student relationships because of the longer quality time they spend together inside the classroom [11, 15]. In a lecture, the teacher barely knows which topic is easy or hard for the students [9]. Nowadays, teachers deliver lectures while blankly looking at their students' eyes and guessing if they are getting the lesson or not. Through student feedback in their reading assignments, the teachers will be able to know their students better, what they know and what they do not know.

Despite the success of the flipped classroom, a feeling of uneasiness was detected in the flipped classroom,

which may be related to the fact that a variety of learning activities were undertaken throughout the course of the class period, in contrast to the traditional teaching technique, which is mainly composed of lectures [24, 26]. The observation was made in the context of activity theory and learning environments in the flipped classroom and in the conventional classroom. This "uneasiness" may be a merit of the flipped classroom attributed to student engagement or an obstacle that requires an effective teacher facilitator. While it seems that videos and virtual chat rooms will displace teachers in the classroom, on the contrary, teachers have become more valuable in the flipped classroom. Their mastery and assistance are needed as they facilitate active learning activities delving into difficult topics in the lesson [3, 15]. The easy part of the lesson will be taken home, while the difficult part will be handled and taken care of by the teacher inside the classroom. The role of the teacher and the characteristics of the classroom environment are the learning facets being considered in this study.

The flipped classroom teaching strategy that was investigated in this study is anticipated to produce positive results in student attitude as well as the classroom environment. This is because the strategy encourages learning at the learner's pace rather than the teacher's pace, and it makes valuable use of class time because students come to class prepared and ready for active learning activities. In a flipped classroom, students study at their own pace, and collaboration is encouraged through peer instruction. Flipped classrooms are characterized by a high degree of individualization. In the environment of peer instruction, there is a strong need for the material that was first acquired through readings in the setting of the flipped classroom. It is anticipated that the Filipino science classroom will be turned into a genuine classroom of the 21st century where quality learning will take place as a result of the combination of these strong instruments, the flipped classroom, and peer education.

The flipped classroom is a significant endeavor in promoting technological teaching pedagogy, which could help teachers improve science instruction by making science education more meaningful and relevant to students. Technology based teaching strategies employed in the early years of education are believed to motivate students to study science related courses and pursue science and technology related careers in the future. The junior high school level, specifically the Grade 7 level of a public school in Sta. Cruz, Laguna, is an appropriate time to develop among students the interest and positive attitude towards science by using science courseware, science videos, and peer instruction in teaching. In reference to the literature review done by the researchers, no study on flipped classrooms involving students in Grade 7 has been conducted for Chemistry in the Philippines. The design of the implementation of the flipped classroom that was used in this study is inexpensive and may be utilized even with a limited amount of resources. The technical application that is being employed demands a modest specification of the gadget and yet still manages to function effectively.

1.3. Purpose of the Research

This study aims to address the need to integrate technology in the classroom and draw insights from the classroom environment that results from the implementation of peer instruction combined with the flipped classroom to improve Chemistry instruction. Specifically, it investigated how a flipped classroom influences the overall classroom environment in terms of positive climate, behavior management, productivity, quality of feedback, language modeling, instructional learning format, and concept development.

2. Methodology

2.1. Research Design

This study used a descriptive research design to explore the characteristics of the classroom environment that result from the implementation of the CC and FC in two intact classes of Grade 7 students.

2.2. Treatment

In this study, the intervention was an FC teaching strategy. The activities in FC are described below.

Before class

Pre-class activities for each lesson were given weekly and conducted offline in the school's computer laboratory on a predetermined schedule. Pre-class activities included Department of Science and Technology (DOST) science courseware and selected science videos with a corresponding set of guide questions, sample problems, and exercises, which the students studied and answered before the class. The students studied the material and answered the exercises individually. Answers to guide questions, sample problems, and exercises were collected and checked at the end of the pre-class activity.

During class

The teacher gave a short review of the lesson before the start of class. The students, being ready for the class, applied, analyzed, evaluated, and created based on what they understood from the pre-class activity. The students answered the conceptual questions through peer discussion, following the sequence below:

1. The teacher posted a question.

2. Each student responded to the questions independently. They demonstrated their answers using Plickers^{TM}, an assessment tool that enables quick assessment of students' understanding of the lecture. Students raised their Plickers cards to express their responses. The teacher used her camera phone to record formative assessment data on the spot.

3. After all students had given their responses, the teacher displayed the percentage of learners who had given the correct answer.

4. Students were instructed to discuss their responses with their chosen partner.

5. Following the peer discussion, the students voted on their answer.

6. The teacher provided the correct answer as well as an explanation.

The same laboratory demonstrations, practice problems, and formative tests were used in the CC and FC groups.

The same teacher handled the classes to ensure control of the content given to the groups and strict implementation of the teaching strategies. However, in the FC, no lecture introducing the new material was given since the students were already introduced to it before coming to class. Another difference worth noting was that tasks that were not accomplished during the class were given as assignments to the students in the CC group. Tables 1 and 2 summarize the flow of activities in the two classrooms.

Table 1: Activities in the Conventional Classroom.

	During class	After class
Teacher Activity	• Provides a lecture based on the DOST science courseware or science video • Organizes activities to get students engaged • Facilitates peer instructions • Delegates tasks	
Student Activity	• Acquires knowledge and comprehension • Performs the activity • Discusses answers to conceptual questions with peers.	• Applies, analyzes, synthesizes, or evaluates what was learned to complete the assignment • Writes journal entries for reflective learning

Table 2: Activities in the Flipped Classroom.

	Before class	During class	After class
Teacher Activity	Provides feedback in pre-class activity	Facilitates the following: • class review • peer instruction • activities for in-depth application, analysis, synthesis, and/or evaluation of concepts	
Student Activity	Acquires knowledge and comprehension from the DOST science courseware or science video	• Answers recall questions • Applies, analyzes, synthesizes, or evaluates activities based on what was learned during the pre-class activities • Discusses answers to conceptual questions with peers.	• Writes journal entries for reflective learning

2.3. Participants and Subjects

Two intact sections of high school students in Grade 7 enrolled in a public high school in Sta. Cruz, Laguna, Philippines, participated in the study. The equivalence of each group was established using a t-test of their pretest score in a Chemistry achievement test (p-value = 0.4155). One group was exposed to CC, and the other to FC. A fourth year BS Mathematics and Science Teaching student from the University of the Philippines Los Banos was requested to sit-in and observe the classes in the two classroom set-ups. He has taken four Field Study courses in his program, which made him qualified to observe the different interactions in class. For the learning content of the study, the researcher followed the Department of Education K-12 science curriculum guide for Grade 7. The following are the lessons covered in each day of observation:

Day 1 - Homogeneous and heterogeneous mixtures

Day 2 - Solute and solvent

Day 3 - Saturated, unsaturated, and supersaturated solution

Day 4 - Pure substances and mixtures

Day 5 - Evaporation as a process

Day 6 - Concentration of solutions (% by mass and % by volume)

Day 7 - Molarity and dilution

Day 8 - Elements and compounds

Day 9 - Information from a periodic table

Day 10 - Subatomic particles

Day 11 - Properties of acids and bases

Day 12 - Indicators of acids and bases

Day 13 - Metals and nonmetals

Day 14 - Difference between observation and inference

2.4. Instrument

The researchers adopted an instrument based on the Classroom Assessment Scoring System™ (CLASS) [5], developed and validated at the University of Virginia Curry, School of Education, to observe the performance of the teacher and the students in the two classroom set-ups. The CLASS is an observation instrument that is focused on assessing the quality of student-teacher instruction inside the classroom. This observation tool was appropriate for this study as it looked deeply into the classroom environment that resulted from the implementation of the intervention. The classroom observation focused on the following aspects of the classroom environment:

- Positive climate;
- Teacher sensitivity;
- Regard for students' perspectives;
- Behavior management;
- Productivity;

- Quality of feedback;
- Language modeling;
- Instructional learning format; and,
- Concept development.

The description of each aspect of the classroom environment utilized in this study are from the CLASS observation instrument. Each aspect was scored on a scale of 1 - 7. A score range of 1 - 2 = low; 3 - 5 = middle, and 6 - 7 = high range (CLASS implementation guide, 2009). The scores given to each classroom were validated through the teacher's journal entry and the observer's comments during the observation. The scores for the two classroom set-ups were graphed and analyzed using the t-test and Mann Whitney-U test.

3. Results and Discussion

This section presents a discussion of patterns in the observer's perceived classroom environment using the CLASS rubric and scoring system. The researchers gave probable explanation and accounted for some distinct observations that were deemed valuable for the implementation of each of the two classroom set-ups using the teacher journal entry and observer comment.

3.1 Positive Climate

A positive climate inside the classroom is indicated by a warm and supportive relationship between the students and the teacher, positive affect, positive communication, and respect. As shown in Figure 3, challenges in establishing a positive climate, especially during the first four meetings in class, were experienced in the FC setting. However, these challenges were successfully overcome at the end of the implementation. The lowest score for relationships was observed in the fourth meeting. The teacher wrote in her journal that during this particular day in science class, the students were looking out the window and seemingly wanted to leave earlier than expected. The teacher suspected that the students' lack of interest in the class was due to the fact that they had previously covered the material during the pre-class activity. This observation was consistent with the result of the positive affect component. The students' behavior necessitated the teacher's correction.

Relationships that develop in the flipped classroom set-up, independent of the method used, are a reliable indicator of the classroom atmosphere [12], as well as the degree to which the flipped approach is successful [21]. The teacher communicated with the students the expectations, responsibilities, and benefits of working in a flipped classroom. This was done because the students were not yet familiar with either the teacher or the new instructional strategy. Additionally, the teacher built connections with the students by responding to queries, which conveyed care and interest; praising student works or activities; and engaging in casual discussion with the students [2]. The subsequent meetings revealed a strengthening of the relationship as well as an increase in positive affect.

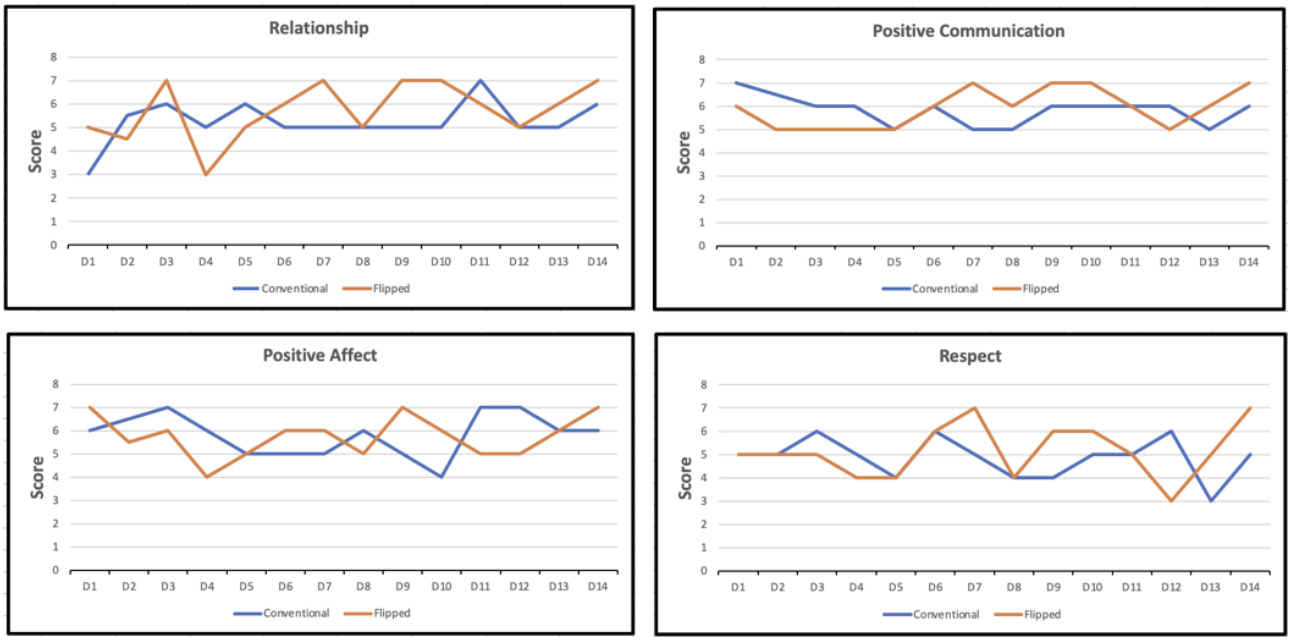

Figure 1: Positive climate as shown in classroom relationship, positive affect, positive communication and respect.

The scores that FC received for respect may be the result of external variables such as the make-up of the activity or the conduct of the students. The score of three was the lowest, and the score of seven was the best in FC for respect. The instructor noticed that the students became too enthusiastic on the day when the lowest score was recorded, and that this happened during the display of laboratory supplies that are used in measuring pH. Positive communication was maintained in the middle to high range.

CC also started out low in terms of relationships. However, it started to increase at the second meeting and was maintained in the middle range. Positive affect started high in CC, went down to the middle range halfway through the implementation, and increased again at the end of the implementation. The lowest score for positive affect in CC was recorded on the 10th day of observation. The journal entry of the teacher showed that during that day, some of the boys were making noise and doing something else at the back of the classroom. Also, the teacher noted that some students were not paying attention but instead were finishing their posters for nutrition month. Positive communication in CC was maintained at a generally high range while the factor respect was observed at a middle range.

Overall, although challenging at first, it is worth noting that FC exhibited a high range score for relationship, positive affect, and positive communication. The results corroborate with the systematic review of [10] that learning environments enhanced with technology, such as hybrid classrooms, had a positive impact on classroom climate. On the other hand, CC, being the conventional method of teaching the students were used to, showed a more steady development of relationship, positive affect, positive communication, and respect at the middle range. Research conducted on traditional face-to-face educational settings has consistently demonstrated that the establishment of a positive social classroom climate yields numerous advantageous effects on social-emotional outcomes among students [10].

3.2 Teacher Sensitivity

The factors contributing to teacher sensitivity were: awareness, responsiveness, addressing problems, and student comfort. As shown in Figure 2, the scores in the two classrooms differ greatly on days 7 to 10. In FC, a high range of awareness and responsiveness was observed on these days, while CC was in the middle range. The teacher was observed to be more aware of and responsive to the needs of the students in FC on days 7 to 10 than in CC. As a result, they were able to smoothly finish all activities scheduled for the day, and the students were more cooperative and participative.

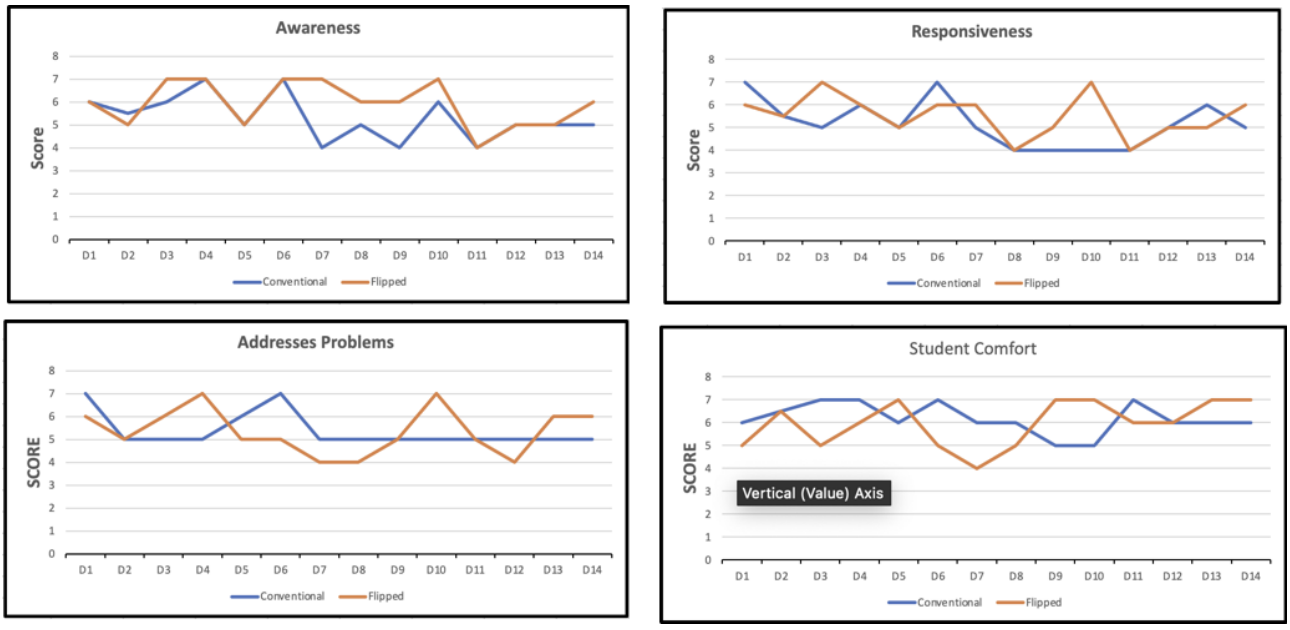

Figure 2: Teacher sensitivity as shown in awareness, responsiveness, addresses problems, and student comfort.

The opposite was observed in CC. The observer recorded on days 7 to 10 that some of the boys were not paying attention during the class, a number of students went out during discussion, some were not participating at all, the students were disorganized during the discussion, and the class was distracted by the foul smell from outside. The teacher could have missed paying attention to the needs of the students because she was too focused on finishing the lesson.

The teacher in FC was observed efficiently addressing problems until day 4 of the classroom observation. However, this decreased to the middle range from the fifth day of observation until the seventh day. On the eighth day until the last day of implementation, the response increased. Addressing the problem factor in CC was relatively maintained in the middle range. The nature of the peer instruction focused more on teacher-centered delivery of content and gave the teacher an opportunity to easily address problems as they occurred. On the other hand, the FC was more focused on the conduct of the activity. The teacher failed to address problems occurring in FC as she was focused on facilitating the activities.

Except for observation days 9 and 10, student comfort was mostly observed at the high range in CC. On day 9, the observer noted that the students tried cheating with their peer instruction answers by writing their answers

even before the question was given. This could have prevented the students from participating freely in class. Also on day 10, the students were distracted by other activities that were not related to science, such as using cellphones and chatting with seatmates, and were not able to freely participate and feel comfortable because of the foul smell from outside. Their lack of understanding of the lesson and engagement during the teacher's lecture could be the reasons why the students resorted to cheating during peer instruction.

Student comfort in FC was observed in the middle to high range. The lowest score for student comfort was on day 7. Aside from the activity, the teacher provided additional instructions for the students to better understand the lesson on molarity and dilution. The nature of the topic could have caused low student comfort in FC.

Overall, the nature of the activity and classroom set-up affected teacher sensitivity, specifically awareness, responsiveness, and addressing problems. Meanwhile, student comfort in terms of seeking support, sharing ideas, and freely participating could be affected by the physical environment and other distractions. Comparing the two classrooms, CC started better in the teacher sensitivity dimension; nevertheless, FC scored better at the end of the implementation. The teacher, regardless of the teaching strategy, should show sensitivity by being aware of students' needs, being responsive, and being able to address problems.

3.3 Regard for Student Perspective

Factors contributing to the student perspective were flexibility and student focus, support for autonomy and leadership, student expression, and restriction of movement. As shown in Figure 3, CC started in the middle range for flexibility and student focus and then increased to a high level on the 3rd day of observation. It obtained relatively higher scores for flexibility and student focus in the succeeding meetings, except in the day 10 observation. This day was also cited in the positive climate and teacher sensitivity dimensions as the day when the students lacked focus because of requirements in other subjects, noisy students, and a foul smell from outside. Factors like noise, hot weather, odor, and seating arrangement constitute the physical environment that can affect the focus of the students and class productivity [12] Appropriate measures should be taken if these factors create distractions during class. In the given situation, the teacher had difficulty organizing instruction around the students' interests. As a result, students in this set-up were able to answer only three concept questions during the peer instruction activity.

Generally, FC obtained a high range score in flexibility and student focus from the start until the end of the implementation, except for day 7 of observation. Though the students in FC had previous exposure to the learning material, they still needed direct instruction to be able to better understand the lesson. The lesson was perceived by the students as difficult, primarily because the topic was something new to them and, secondly, because it required mathematical computations. Despite this, the teacher still continued with the planned instruction for the day.

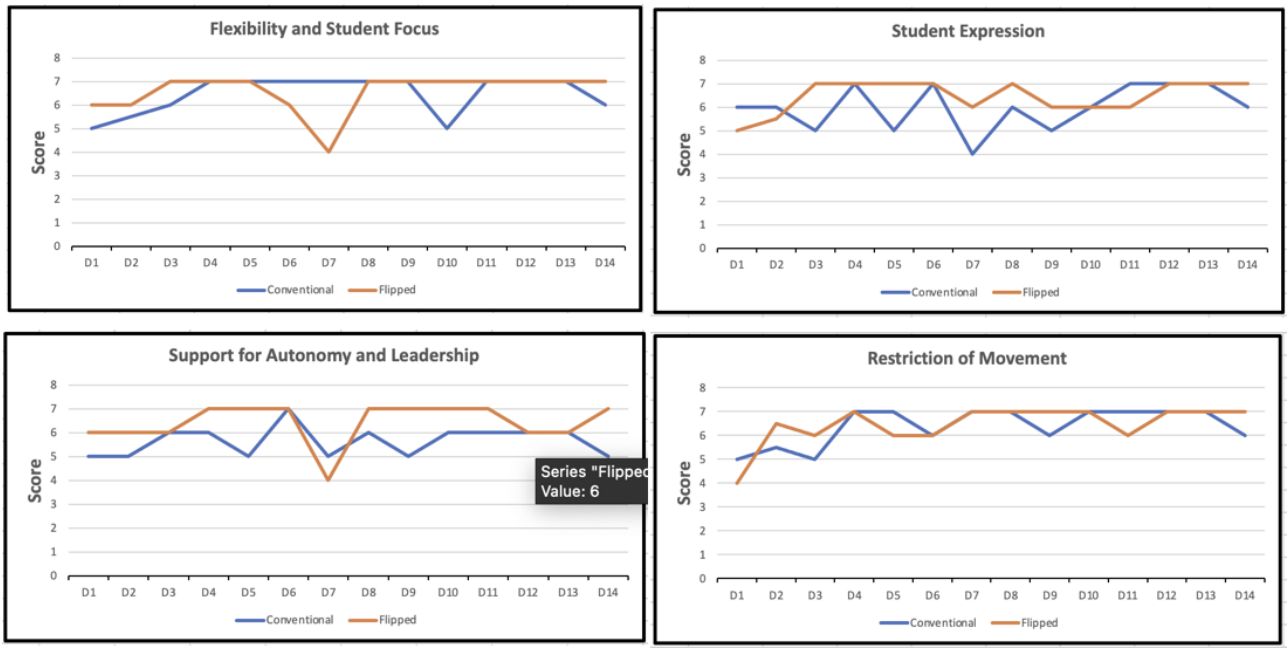

Figure 3: Regard for student perspective as shown in flexibility and student focus, support for autonomy and leadership, student expression, and restriction of movement.

For the support for autonomy and leadership factors, FC was in the high range except for day 7 observation, where the score obtained was the lowest of 4. This day was also cited in the discussion on flexibility and student focus. Since the students needed more time to practice the lesson and follow the instructions of the teacher, they were not given full autonomy to decide on the lesson. The students might feel uncomfortable while adjusting to the new teaching strategy because it requires them to be responsible for their own learning [1]. In this case, the students should be provided support, expectations communicated, and put into perspective. This will increase their willingness to cooperate and participate in the implementation of the flipped classroom [25]. On the other hand, the scores in CC were steadily observed to be in the upper limit of the middle range to the lower limit of the high range, with an exception to day 6 observation, where the highest score was recorded.

For student expression, which is described as the opportunities for student talk and expression, the scores in FC started in the middle range, then increased and were maintained at the high range starting on day 3. On the other hand, there was an observed fluctuation in the range of scores for student expression in CC. The scores for student expression in this set-up jumped from the middle range to the high range in most observations and gained a straight high range towards the end of the implementation. The lesson on molarity and dilution was recorded to have the lowest score for student expression in CC because the nature of the lesson requires direct instruction from the teacher. A close pattern of restriction of movement was observed in the two classrooms. Both began with middle-range scores at the start of the implementation and then progressed to high-range scores by day four. The students in both classrooms were free to move and were not rigid, especially during activities.

To summarize, regard for the student perspective, specifically flexibility and student focus, and support for autonomy and leadership were affected by the nature of the lesson and its level of difficulty. Some lessons required sufficient teacher instruction before autonomy and leadership were given to the students. The activities

implemented in the classroom greatly affect the level of student expression and the restriction of movement in the classroom. The findings of this study showed that CC and FC promoted regard for student perspective, restriction of movement, flexibility, and focus. However, student expression, and support for autonomy and leadership were better in FC. Granting autonomy and leadership to students can be done more easily in FC because of the prior understanding of the lesson the students gained from the pre-class activities. The students in FC have greater capability to share ideas and express themselves because of their familiarity with the lesson and the confidence they gained in performing the pre-class activity.

3.4 Behavior Management

Clear behavior expectations, being proactive, redirecting misbehavior, and maintaining high expectations for student conduct all play a role in effective behavior management. To ensure that students are properly led and are aware of the behavior that is expected of them in class, teachers should go through the classroom or house rules they have established with their students at the beginning of each class [27]. Figure 4 demonstrates that up until day 4 of the class observation, the instructor in FC had low marks in terms of defining clear behavior expectations for the students. Despite this, the highest score of seven points was achieved on the fifth day of observation for unambiguous behavior expectations. When the teacher was able to create a connection with her class, an improvement in student behavior was observed. Since the teacher had communicated her expectations to the students for both pre-class and in-class activities, it was apparent that the students participated more actively in the group activity and were more cooperative overall. In subsequent courses, it was noted that students who met the explicit behavior expectation obtained scores in the middle to high range. Because of the activity-based nature of the FC, the teacher was able to set clear behavioral expectations for the students.

The teacher in CC also started with low scores in setting clear behavior expectations, which increased to a score of 7 on the third observation day. However, it went down again to the middle range until the end of the implementation. The lowest score recorded for CC for clear behavior expectations was 3 on day 10. As mentioned in the previous section, the teacher failed to set clear behavior expectations to handle students who were not paying attention or doing things for other subjects and were distracted by the physical environment outside; possibly because she was too focused on finishing the lesson for the day. To improve this aspect of the classroom environment, the teacher can post on the classroom wall the set of rules to be implemented in class. The teacher should also constantly remind the students of the agreed-upon house rules.

The teacher in the two classrooms was characterized by middle range proactive behavior. This indicated that the teacher used a combination of proactive and reactive responses; sometimes she monitored and reacted to early indicators of behavior problems, but other times she missed or ignored them. Remarkably, a high proactive score was given to the teacher in the FC on day 6. The nature of this classroom gave the teacher an opportunity to be proactive in preventing problems from developing. Based on how the students perceived the lesson for day 6, which was percent by mass and percent by volume, during the pre-class activity, the teacher was able to prepare a suitable activity for the actual class. Both classrooms showed middle range character for the redirection of misbehavior. As a direct consequence of this, inappropriate conduct seldom persisted, worsened, or diverted attention away from the process of learning. The score for this aspect of behavior control that was

earned in CC on day 7 was the lowest. The observer saw that some students at the back of the room were not paying attention to the discussion that was going on. On the other hand, day 13 of the observation yielded the highest score for this component in the FC. Even though there was a power outage in the middle of class, the students were attentive, and they even had a perfect score during the peer instruction portion of the lesson.

Figure 4: Behavior management as shown in clear behavior expectation, being proactive, redirection of misbehavior, and student behavior.

The score graph for student behavior in the two classrooms showed a distinctive trend. On the first four days of observation, poor student behavior was observed in FC. This was demonstrated by the teacher's writing in her journal, in which she described the students' lack of interest in the lesson, their agitation and desire to leave the classroom, as well as their disruptive behavior. The opposite was observed in CC. As the implementation of the teaching strategies in the two classrooms progressed, the students in FC became cooperative, engaged, and attentive, while the students in CC became noisy, inattentive, and distracted in class. The initial reaction of the students in CC could have been caused by the novelty of the technology used in the classroom. However, the FC implemented in the other section later on resulted in improved student behavior as students realized the importance of pre-class activities in understanding the lesson. This set-up also accommodated activities, which students liked better than a mere lecture. The findings showed that both classrooms promoted redirection of misbehavior and proactiveness. On the other hand, it was observed that the utilization of FC provided the teacher with an increased number of chances to be proactive depending on the students' performance in the pre-class activities. According to the findings, FC was successful in improving student behavior in the classroom by getting them involved in activities and providing them with background information that helped them do better in class. It was acknowledged that establishing explicit behavior expectations was an essential component of behavior management in FC. Because this type of classroom is oriented toward the students and built around activities, the teacher needs to be effective in communicating what is expected of them in terms of their behavior.

3.5 Productivity

The factors that contributed to classroom productivity were maximizing learning time and transitions. As shown in Figure 5, CC and FC were observed to display middle-to-high range character in maximizing learning time. However, FC reached the highest score of 7 more frequently (four times) than CC (twice only). The four lessons in which class time was highly maximized in FC were: a) percent by mass and percent by volume; b) effect of heat on elements and compounds; c) subatomic particles; and d) metals and nonmetals. On the other hand, the two lessons where the class time was highly maximized in CC were: a) saturated and unsaturated solutions; and b) evaporation. The lowest score of 4 observed for maximizing learning time was in CC on day 6 of the observation. Although the students successfully completed the activity, much of the time was spent addressing disruptions in class on day 6. This indicated that the teacher provided activities for the students most of the time. However, some learning time was lost in dealing with disruptions.

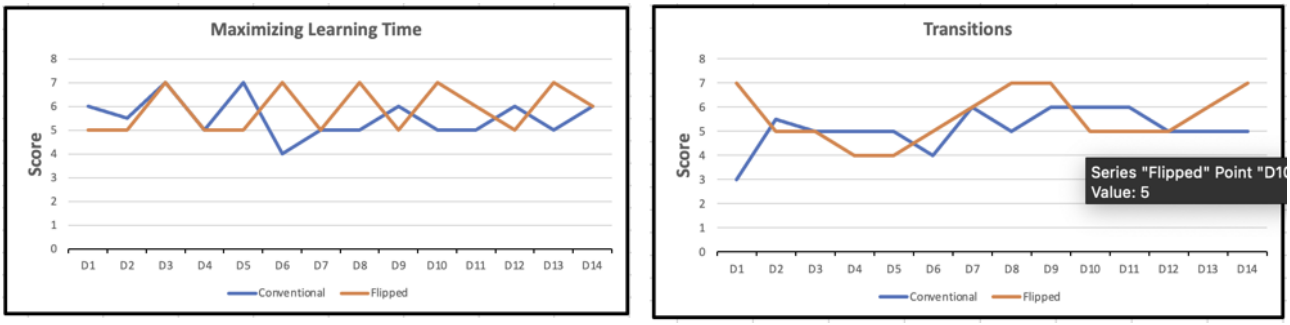

Figure 5: Productivity as shown in maximizing learning time and transition.

A smooth transition in activities was another challenge encountered in the two classrooms. The score was raised to a high level with a score of 6 on the 7th day of classroom observation. The trend for transition in peer instruction was more steady in CC and was relatively in the middle range. However, the trend in FC was more fluctuating: starting from very high, going down to the middle range, then going up again to very high. Focusing on FC, the lowest scores for transition were on days 4 and 5. The observer recorded the time to prepare for the activity or the transition to be 7 minutes on days 4 and 5. As noted by the observer, the transition time was reduced to 1, 2, and 5 minutes during the observation days 8, 9, and 13, respectively, when the highest scores for transition in FC were obtained.

3.6 Quality of Feedback

The factors contributing to the quality of feedback were: scaffolding, feedback loops, prompting through processes, providing information, and giving encouragement and affirmation. As shown in Figure 6, the teacher successfully provided high-quality feedback in both classrooms in the form of scaffolding, feedback loops, prompting thought processes, providing information, and giving encouragement and affirmations.

The trends for scaffolding, feedback loops, prompting thought processes, and providing information are almost the same in the two classrooms. On the final day of implementation, both classrooms received the same scores

of 7, 6, and 7 for scaffolding, prompting thought processes, and providing information, respectively. However, better scores on feedback loops were obtained in FC towards the end of the implementation.

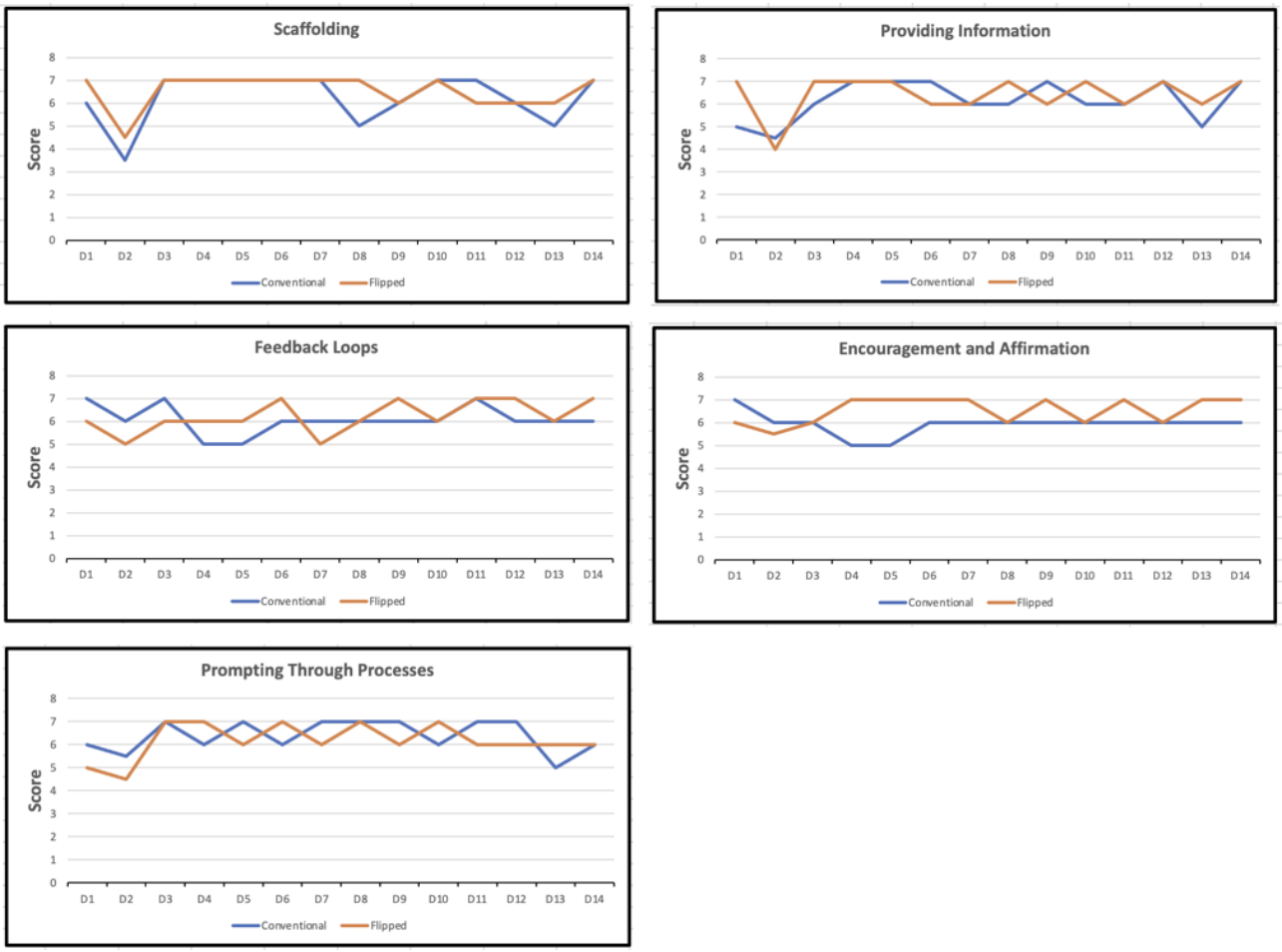

Figure 6: Quality of feedback as shown in scaffolding, feedback loops, prompting through processes, providing information, and giving encouragement and affirmations.

For the factor encouragement and affirmation, the scores in CC started at a very high range, went down to the middle range on the 4th and 5th days of observation, then went up again on day 6 of observation, and were maintained at the lower limit of high range until the end of the implementation. In FC, more instances of the teacher giving encouragement and affirmation to students were observed. The activities in FC were good venues for the teacher to give encouragement and affirmations to students whenever they had accomplished a task. On the other hand, encouragement and affirmation were given to the students in CC during recitation and discussion.

3.7 Language Modeling

Factors affecting language modeling were frequent conversations, open-ended questions, and the extension of student responses. As shown in Figure 7, CC and FC got close scores for frequent conversation and open-ended questions. There were frequent conversations in both classrooms between the teacher and the students.

Conversation between peers in the two classroom setups mostly came from the peer instruction part.

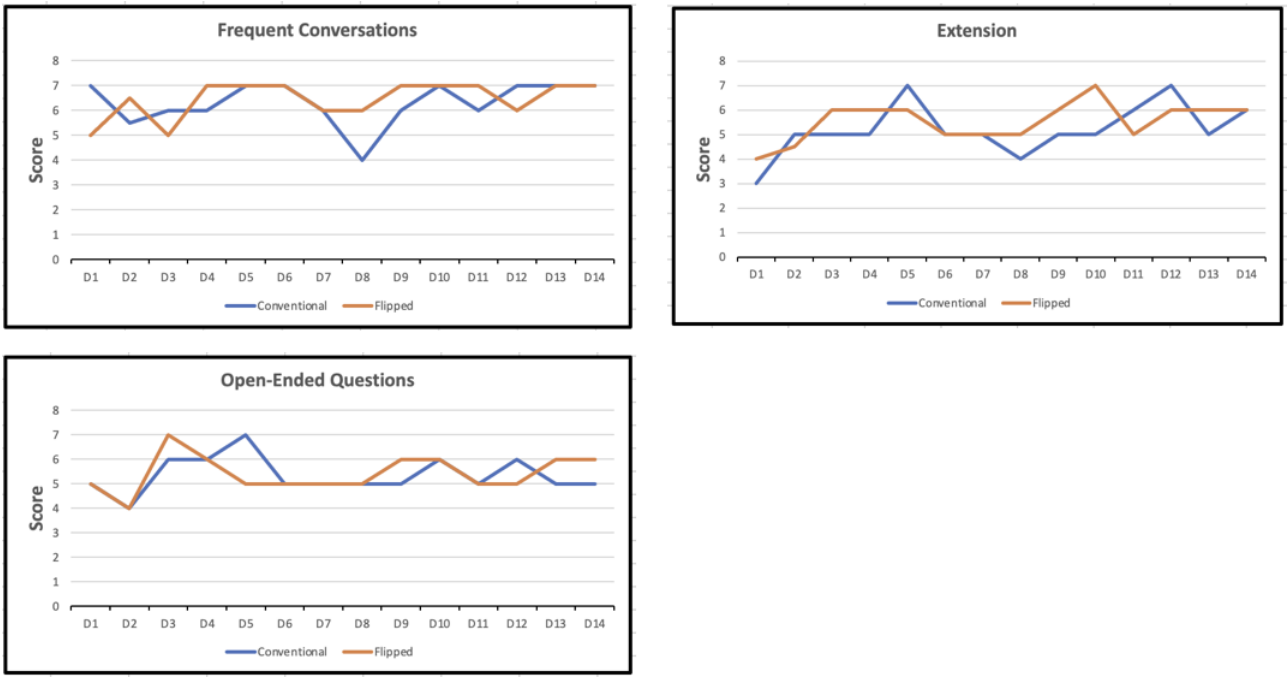

Figure 7: Language modeling as shown in frequent conversation, open-ended questions, and extension.

Additional conversation between peers occurred in FC during class activities. The lowest score of 4 for frequent conversation was recorded on day 8 in CC. The average scores in the FC and CC set-ups for frequent conversation were 6.32 and 6.46, respectively. This indicated that there were frequent conversations in both classroom set-ups. For open-ended questions, the average score in the FC and CC set-ups were 5.36 and 5.43, respectively. This indicated that the teacher asked a mix of closed-ended and open-ended questions during class. As reported in the teacher's journal, most of the class time was spent copying notes. The class took longer because they were distracted by other students outside the classroom.

Both classrooms started with low scores on extension of student responses. The high range score of 6 was reached on day 3, while in CC, the high range score of 7 was reached on day 5 of observation. The frequent teacher-student conversation led to an extension of the students' response.

3.8 Instructional learning format

The factors that contributed to the instructional learning format were effective facilitation and student interest. According to the authors in [18] effective facilitation is one of the essential elements that could open the door to learning math for all students. As shown in Figure 8, the majority of the scores in the two classrooms for effective facilitation were in the high range. The teacher successfully encouraged participation and involvement in peer instruction and in other activities implemented in class. CC obtained low scores in effective facilitation on days 2, 8, and 13. Based on the journal entry of the teacher on day 2, the teacher was still polishing the implementation of the peer instruction activity; on day 8, most of the class time was used for copying notes; and

on day 13, there was a power interruption, and the teacher was not able to encourage high participation and involvement among the students in CC.

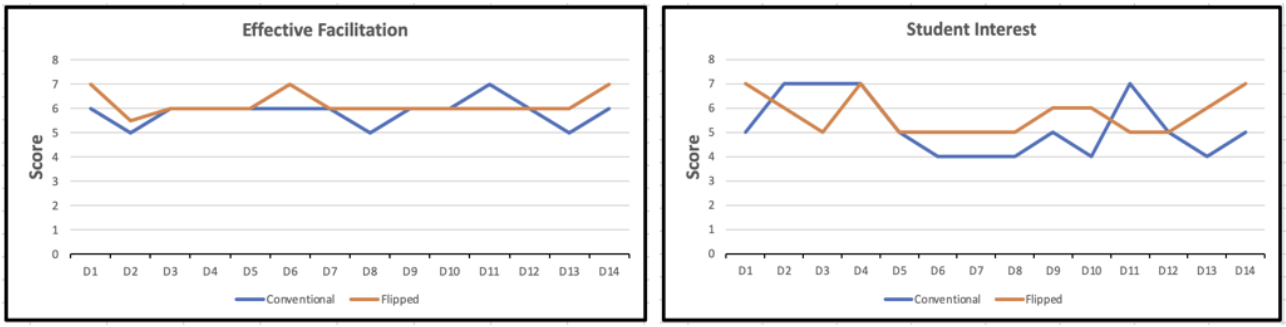

Figure 8: Instructional learning format as shown in effective facilitation and student interest.

In FC, there was declining student interest on the first 3 days of classroom observation. As mentioned previously, the students were familiarizing themselves with the flipped classroom teaching strategy. The increase in student interest was seen on day 4 of the classroom observation. This was from the upper limit of the middle range to the lower limit of the high range until the end of the observation period. FC scored higher than CC starting on day 6 of classroom observation, except on day 11. The authors in [7] used a questionnaire and grade comparison to increase learning outcomes and student interest in an organic chemistry course utilizing the flipped classroom technique. The survey comprises 14 Likert scale items and four open-ended items. The student satisfaction assessment revealed that most students believed the flipped classroom taught them better, improved their learning outcomes, and was more fun than traditional classroom instruction.

3.9 Concept development

Factors such as analysis and reasoning, creation, and integration contribute to concept development. As shown in Figure 9, FC obtained high scores in analysis and reasoning compared to CC. The design of the former gave the students more opportunities to solve problems, as well as compare and classify matters, which were not present in CC, where the main source of analysis and reasoning activity was the peer instruction activity. Students who are actively engaged in class tend to perceive the content delivered to be more meaningful [4, 19]. The score on analysis and reasoning was especially low on Day 5 in CC because the class did not start on time that day; hence, the peer instruction activity was not conducted.

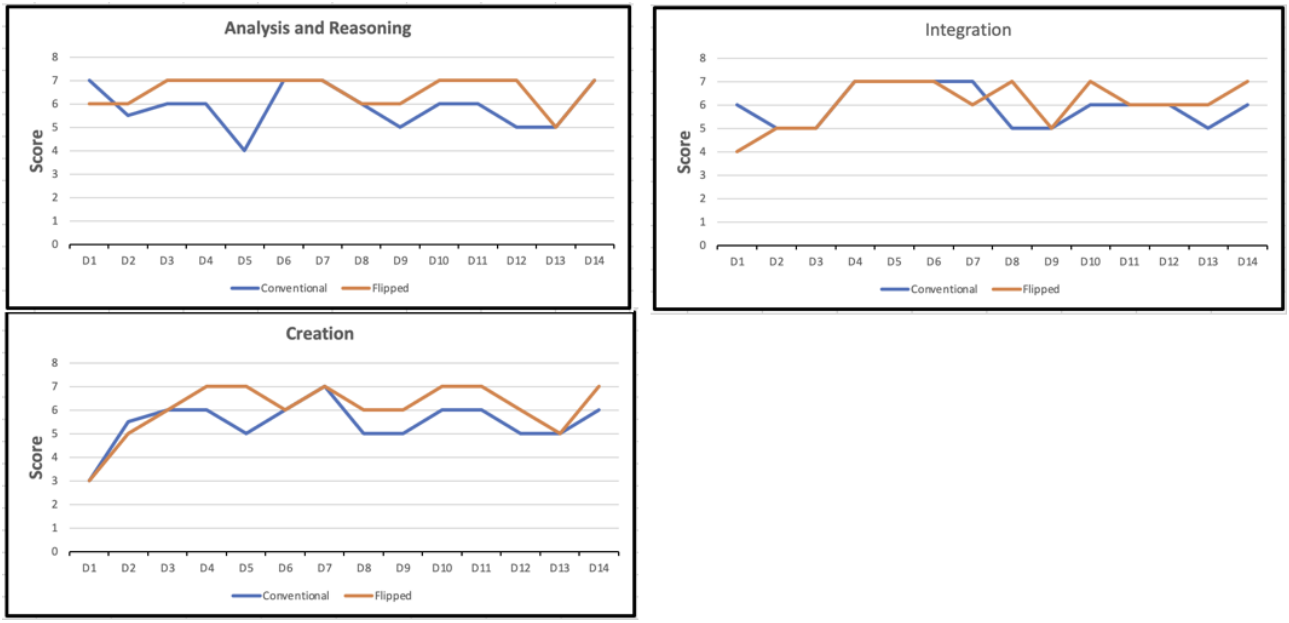

Figure 9: Concept development as shown in analysis and reasoning, creation, and integration.

The creation and integration factors showed the same trend for the two classrooms, although the scores in FC were higher than in CC. The two classrooms promoted concept development through analysis and reasoning, as well as creation and integration. It is worth noting, though, that a better score was obtained in FC for providing opportunities for students to engage in activities that promote analysis and reasoning, creation of new ideas, and integration of concepts and activities to previous learning. This could be attributed to the alignment of the pre-class and in-class activities [17]. A similar benefit was observed by the authors in [6] as he used flipped classroom approach to explore deep learning of concepts in his class. The flipped classroom also helped the students connect new and previous knowledge.

4. Statistical Analysis

The mean classroom observation scores obtained by the two set-ups underwent statistical analysis to determine if there was a significant difference in the classroom environment between the two classroom setups. Before proceeding to the statistical analysis, the assumptions for normality of population and homogeneity of variance were checked. A summary of the mean scores for each classroom was appended to this article. Days 1, 2, 3, 5, 7, 8, 9, 11, and 13 satisfied the assumptions of normality and homogeneity of variance and were analyzed using a t-test. Days 4, 6, 10, 12, and 14 were analyzed using the non-parametric Mann-Whitney U test.

Analysis showed that there was sufficient evidence to say that the classroom environment on class observation days 8, 9, 10, 13, and 14 were significantly different for the two classroom set-ups, with the FC set-up having a better classroom environment. The type of classroom environment FC promotes is an important consideration in implementing flipped classrooms, as it greatly affects the learning and achievement of the students [27]. A positive classroom environment is an indicator that the teaching strategy being implemented is effective, and finding ways to improve it is considered a preventive approach to promote learning and eliminate misbehavior

in class. On the other hand, classroom set-ups characterized by the direct transmission of knowledge were seen to display a negative classroom disciplinary climate [22]. Table 3 showed the summary of the analysis.

Table 3: Observation days which showed significant difference between the classroom environments between CC and FC.

Observation Day	Group	Classroom observation mean score	Test for comparison	p - value
Day 8	FC	5.81	t-test	0.0152
	CC	5.13		
Day 9	FC	6.06	t-test	0.0012
	CC	5.29		
Day 10	FC	6.52	Mann-Whitney U test	< 0.0001
	CC	5.32		
Day 13	FC	6.03	t-test	0.0006
	CC	5.23		
Day 14	FC	6.68	Mann-Whitney U test	< 0.0001
	CC	5.68		

Lack of understanding of the lesson and engagement during lectures could be the reasons for the disruptive behaviors of students in the traditional classroom. This greatly affects the overall classroom environment. Prior understanding of the lesson the students had from the pre-class activities made them more comfortable and confident in class and capable of sharing ideas and self-expression. In a positive classroom environment, students can develop confidence, a sense of safety, and joy, which can greatly influence the way they participate and perform in class.

5. Conclusions

FC was challenged in the first few days of its implementation in the classroom environment, specifically in the aspects of positive climate, behavior management, quality of feedback, productivity, and concept development. However, FC triumphed, as it scored better in all aspects of the observed classroom environment at the end of the implementation. FC showed a better classroom environment than CC.

6. Recommendations

Teachers implementing the FC teaching strategy should be vigilant in developing a classroom environment, specifically in the following aspects: positive climate, behavior management, quality of feedback, productivity, and concept development. The results of the study found the following aspects useful in overcoming these challenges and developing a positive classroom environment in a flipped classroom:

1. Give students sufficient briefing about the benefits of the flipped classroom, its structure, and the new expectations set for them. It is natural to see resistance among students whenever a new teaching

strategy is implemented in class. That is why it is also crucial that the teacher who will be implementing the flipped classroom "sell" the concept to the students by explaining the advantages of the new format as well as the roles that will be expected of them in the new environment.

2. Provide the students with needed support, communicate expectations, and put them into perspective as they adjust to the new teaching strategy. This will make them more comfortable, participative, and cooperative in class.

3. Motivate the students to finish the pre-class activities. Explain to the students the importance of the pre-class activities in understanding the lesson and their performance in class. It is suggested that students be recognized and graded for finishing the pre-class assignments.

5. Make clear to the students that the pre-class activities are not a replacement for their classes. Since the material to be discussed in class was already given beforehand, students might not attend the class or not pay attention during class discussion, particularly if they understood the topic well during the pre-class activity.

4. Encourage students to work on their own and not depend too much on the teacher. Teachers should play the role of a guide because flipped classrooms center on students performing activities in class.

5. Constantly remind the students of the house rules agreed-upon and implemented in class.

Recognizing the challenges of developing a positive classroom environment, teachers should be given support and training on how to modify the classroom environment to encourage academic engagement and discourage disruptive behaviors in class. It is possible that some teachers need extra support in establishing an effective learning environment, for instance, in developing teacher-student relations.

References

[1] Arnold-Garza, S. (2014). The flipped classroom teaching model and its use for information literacy instruction. *Communication in Information Literacy.* 8(1): 7-22. Towson University.

[2] Barr, J. J. (2016). Developing a positive classroom climate, IDEA paper #61. The IDEA Center.

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

[4]Bormann, J. (2014). Affordances of flipped learning and its effects on student engagement and achievement. University of Northern Iowa.

[5] CLASS implementation guide (2009). University of Virginia Curry School of Education. Measuring and Improving Teacher-Student Interactions in PK-12 Settings to Enhance Students' Learning. Center for Advanced Study of Teaching and Learning Charlottesville, Virginia. Retrieved on April 14, 2016

from www.curry.virginia.edu/castl.

[6] Danker, B. (2015). Using flipped classroom approach to explore deep learning in large classrooms. *The IAFOR Journal of Education*. 3(1): 171-186.

[7] Dehghan, S.; Horan, E. M.; Frome, G. (2022) Investigating the Impact of the Flipped Classroom on Student Learning and Enjoyment in an Organic Chemistry Course. Journal of Chemical Education, *[s. l.]*, v. 99, n. 7, p. 2512–2519, 2022. DOI 10.1021/acs.jchemed.1c01104. Disponível em: Retrieved on August 19, 2023 from https://research.ebsco.com/linkprocessor/plink?id=01d9ac98-77a8-3076-8f35-22f3322bf55c.

[8] Department of Education Discussion Paper. (2010). Discussion paper on the enhanced K+12 basic education program.

[9] Fulton, K. P. (2012). 10 reasons to flip. *Phi Delta Kappan*. 94(2): 20-24.

[10] Goagoses, N., Suovuo, T., Winschiers-Theophilus, H., Montero, C. S., Pope, N. H., Rötkönen, E., & Sutinen, E. (2023).

[11] Hani, M. (2014). Flip your classroom to increase academic achievement. *Childhood Education*. (90)3: 239-241.

[12] Hannah, R. (2013). The effect of classroom environment on student learning. Honor Thesis Paper 2375. Western Michigan University.

[13] Hantla, B. F. (2014). Flip your classroom: Reach every student in every class every day. *Christian Education Journal*. 11(1): 183-188. Retrieved from http://search.proquest.com/docview/1517636103?accountid=47253

[14] Hennick, C. (2014). Flip your classroom. *Instructor*. 124(2): 21-23. Retrieved on April 14, 2016 from http://search.proquest.com/docview/1613618815?accountid=47253

[15] Herreid, C.F. and Schiller, N.A. (2013). Case studies and the flipped classroom. *Journal of College Science Teaching.* 42(5).

[16] Jensen, J.L., Kummer, T.A., and Godoy, P.D.d.M. (2015). Improvements from a flipped classroom may simply be the fruits of active learning. *CBE—Life Sciences Education*. 14: 1–12.

[17] Kim, M.K, Kim, S. M., Khera, O. and 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.

[18] Krall, Geoff (2018) Necessary Conditions : Teaching Secondary Math with Academic Safety, Quality Tasks, and Effective Facilitation. [Portsmouth, NH]: Stenhouse Publishers, 2018. Disponível em:

Retrieved on August 2023 from https://research.ebsco.com/linkprocessor/plink?id=b62fbd96-539f-32f4-bd7b-18442bddf582.

[19] Lemmer, C. (2013). A view from the flip side: using the "inverted classroom" to enhance the legal information literacy of the international LL.M. student. *Law Library Journal*. 105(4): 461-491.

[20] Mazur, E. (2009). Farewell. Lecture?. Retrieved on April 14, 2016 from www.sciencemag.org.

[21] McCollum, B. M., Fleming, C. L., Plotnikoff, K. M., and Skagen, D. N. (2017). Relationships in the Flipped Classroom. *The Canadian Journal for the Scholarship of Teaching and Learning*. 8 (3): 1-19. Retrieved on April 14, 2016 from http://ir.lib.uwo.ca/cjsotl_rcacea/vol8/iss3/8

[22] Organisation for Economic Cooperation and Development (2009). Creating effective teaching and learning environments: first results from TALIS-Executive Summary.

[23] Sarawagi, N. (2013). Flipping an introductory programming course: yes you can!. *Journal of Computing Sciences in Colleges*. 28(6): 186-188.

[24] See, S., and Conry J.M.(2014). Flip My Class! A faculty development demonstration of a flipped-classroom. *Currents in Pharmacy Teaching and Learning*. 6(4): 585–5882. doi:10.1016/j.cptl.2014.03.003.

[25] Shih, W. L., and Tsai, C. Y. (2017). Students' perception of a flipped classroom approach to facilitating online project-based learning in marketing research courses. *Australian Journal of Educational Technology*. 33(5): 32-49.

[26] Strayer, J. F. (2007). The effects of the classroom flip on the learning environment: A comparison of learning activity in a traditional classroom and a flip classroom that used an intelligent tutoring system. The Ohio State University, ProQuest Dissertations Publishing.

[27] Turano, A. A. (2005). The impact of classroom environment on student learning. Theses and Dissertations. 1089. Retrieved on November 2019 from http://rdw.rowan.edu/etd/1089

[28] Wieman, C. (2008). Science education in the 21st century using the tools of science to teach science. Forum for the Future of Higher Education. Retrieved on October 2019 from forum.mit.edu.