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The Impact of the Flipped Classroom Model (FCM) on the Academic Intrinsic Motivation (AIM) and Lesson Planning for Science Teacher-students in the Postgraduate Professional Teaching Diploma (PPTD) Program at Al Ain University: A Case Study

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A R T I C L E I N F O

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A B S T R A C T

Purpose: This study aimed to investigate the influence of the flipped classroom model (FCM) on academic intrinsic motivation and lesson planning for science teacher-students enrolled in the postgraduate professional teaching diploma (PPTD) program at Al Ain University in the United Arab Emirates. **Design / methodology / approach:** The investigation employed a quasi-experimental design. The research sample consisted of (83) male and female PTTD science teachers attending Al Ain University during the first semester of 2022/23, who were divided into two groups: a control group consisting of (43) teachers and accounting for (51.8% of the total sample) and receiving traditional instruction; and an experimental group, consisting of (40) teachers and accounting for (48.2%). Study resources include a lesson planning rubric, an evaluation tool for lesson planning, and an academic intrinsic motivation scale. SPSS was utilized to analyze the gathered data. **Findings:** The lesson planning rubric showed statistically significant differences in favor of FCM-consistent instruction between study groups. In addition, at a significance level of α=0.05, there were no statistically significant differences between academic intrinsic motivation (AIM)-related arithmetic means in relation to differences in teaching methods (traditional versus flipped learning). **Practical implications:** The study recommended implementing the flipped learning strategy in the field and providing instructors with training. **Originality/value:** This study investigated the impact of the Flipped Classroom Model (FCM) on Academic Intrinsic Motivation (AIM) and Lesson Planning for Science Teacher-students in the unique Postgraduate Professional Teaching Diploma (PPTD) Program. This study contributed significantly to the corpus of knowledge because no previous research has examined this relationship.

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1. Introduction

Due to the rapid expansion and global pervasiveness of scientific inventions, knowledge has exploded in such a way that the current era has been termed the information revolution and knowledge explosion. Due to the information revolution, human knowledge, primarily in science and technology, has exponentially increased and doubled (Alsalhi, 2020). Such alterations are regarded as significant obstacles for educational systems worldwide. Education fundamentally transmits intergenerational legacy and fosters various intellectually-grounded growth experiences and situations for multiple individuals. Given that pedagogy is a central component of the educational process, the ever-evolving disciplines of knowledge necessitate a concomitant expansion of instructional techniques and methods. When exceptional and extraneous variables enter the instructional milieu, a teacher's well-adopted teaching method can assist in compensating for curriculum deficiencies. During the outbreak of the covid-19 pandemic, face-to-face instruction arbitrarily transitioned to virtual instruction (Alsalhi et al., 2021; Barrios et al., 2022), compelling institutions to revise their instructional methods. TheMostce-to-face instructional strategies were then phased out and replaced by distance learning methods.

Even after the subsidence of the covid-19 pandemic, unorthodox instructional methods, such as flipped classrooms, have gained popularity due to educational institutions' overhaul and realignment of instructional methods as well as the development and incorporation of modern pro-learning and pro-teaching technologies, such as social media, smartphones, and tablets (Alyoussef, 2022). The flipped classroom model (FCM) had existed since 2012 when Bergmann and Sams coined the term FCM or simply Flipped Classroom (FC). The term "flipped classroom" is used more frequently in primary education in the United States (Awidi & Paynter, 2019), but FCM has recently reemerged as a suitable post-covid-19 model. FCM overturns the conventional learning model in which academic content is delivered in the classroom and then applied at home. In FCM, however, learning begins at home through video or other media, and then classroom lessons are devoted to a teacher-guided, home-initiated individual or group learning activities (Alqahtani, Yusop, & Halili, 2022; Oyaid & Alshaya, 2020).

Consequently, the conventional pattern of "classroom listening" and "home problem-solving" (i.e., homework) changes to "classroom listening" and "home listening" (Tsai et al., 2020). In addition, FCM enables teachers to prioritize active learning during classroom time by designating learning material and PPTs that students can engage with at home or outside of the classroom, thereby diminishing "home learning" and "home listening" and enhancing "class work and learning." Consequently, FCM makes classroom time more enjoyable, productive, and conducive for students and instructors (Lesley University, 2023). FCM is founded on constructivist theory, which views learning as an active process and the student as a dynamic, nonpassive learner who constructs knowledge experientially (Al-Hajeri, 2021). Several studies (Bergmann & Sams, 2012; Bretzmann, 2013; Oyaid & Alshaya, 2020; Shaqlal, 2018) indicate that FCM is a multi-step process that can be roughly divided into two primary phases (Figure 1).

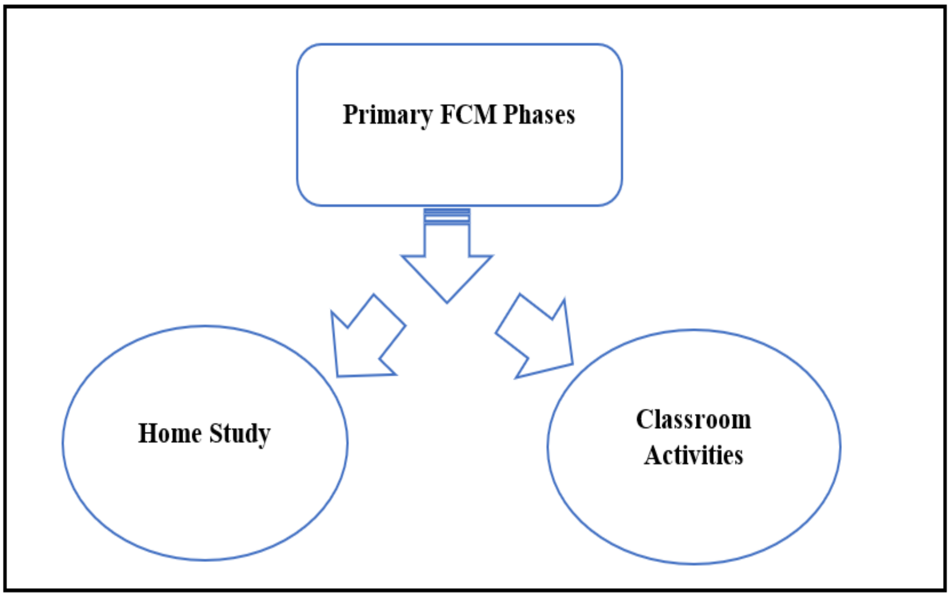

Figure 1. *Two Primary FCM Phases*

In phase one (home study), the teacher establishes student objectives and skills, administers a pre-assessment, identifies appropriate content and technology, templates content in a digital format accessible to students, assigns inherently practical problem-solving tasks, and employs a formative assessment instrument. On the other hand, students prepare by watching a video, listening to a podcast, reading articles, responding to questions that probe their knowledge and encourage reflection, and recording and sharing questions via predetermined teacher-student communication media. Ultimately, the teacher examines the pre-lesson written work of the students and then classifies and designs academic content based on the students' inquiries. In Phase Two (classroom activities), following the constructivist theory predicated on asking questions, seeking answers, and solving problems, the teacher poses the questions or problems, and the students collectively seek answers and solutions. At this stage, the teacher observes ongoing learner-to-learner conversations and provides guidance and assistance as necessary. Notably, the teacher's function as the leader, foundation, and focal point of the learning process shifts to that of an active member guiding, directing, and stimulating a group of students, assisting them in overcoming obstacles and promoting their self-learning abilities. Simultaneously, the learners' previous function as passive recipients of knowledge are transformed into learners efficiently directing and directing their learning experience and actively applying and exploring newly acquired knowledge.

Positives associated with FCM include the following (Al-Hajeri, 2021; Alyoussef, 2022; Oyaid & Alshaya, 2020; Tsai et al., 2020). It allows students to repeat the lecture following their differences and comprehension skills. In addition, it permits the instructor to use class time for guidance, stimulation, and assistance. On the other hand, it enhances teacher-student relationships and promotes the prudent use of advanced educational technology. In the meantime, it transforms the pupil into an active researcher of knowledge sources. In addition, it promotes critical thinking, self-learning, communication, and cooperation skills and ensures the best and most efficient use of class time. FCM-related disadvantages include the following: it is time-consuming and demanding for teachers, as lesson planning requires meticulous academic content preparation, and it requires teachers to develop additional technical skills, such as video and animation production and editing.

According to research, only fifty percent of teachers have the requisite FCM development skills (Alyoussef, 2022). In addition, FCM effectiveness depends on the learners' enthusiasm and motivation. The teacher's instructional strategy and classroom management motivate students to learn. Before learning can occur, learners must have a purpose. Without motivation, knowledge is impossible because there is no learning behavior; motivation causes behavior (Phillips & More, 2022), highlighting the importance of motivation in causing learning.

Motives can be categorized as physiological, psychological, intrinsic, or extrinsic. Intrinsic motivation is an internal force that propels learners toward the activity, fostering perseverance and tenacity without external rewards. Intrinsic motivation correlates with various positive school outcomes, such as academic achievement, creativity, comprehension, satisfaction, and profound learning strategies (Corpus, McClintic-Gilbert, & Hayenga, 2009). Stokes-Zoota (2000) defines intrinsic motivation as the desire to perform a task solely for its inherent characteristics.

Similarly, academic intrinsic motivation (AIM) refers to engaging in an activity for its own sake, rather than for a distinct outcome (Lepper, 2005). Therefore, to facilitate the attainment of planned educational goals, the teacher should encourage the intrinsic motivation of students to learn. Unlike intrinsic motivation, extrinsic motivation is based on rewards, whereas self-motivation refers to the enjoyment of performing tasks. The cognitive engagement exhibited by a pupil during learning tasks and activities is a defining characteristic of learning motivation. Figure 2 depicts several aspects of AIM-related learning stimuli (Lepper, Corpus, & Iyengar, 2005).

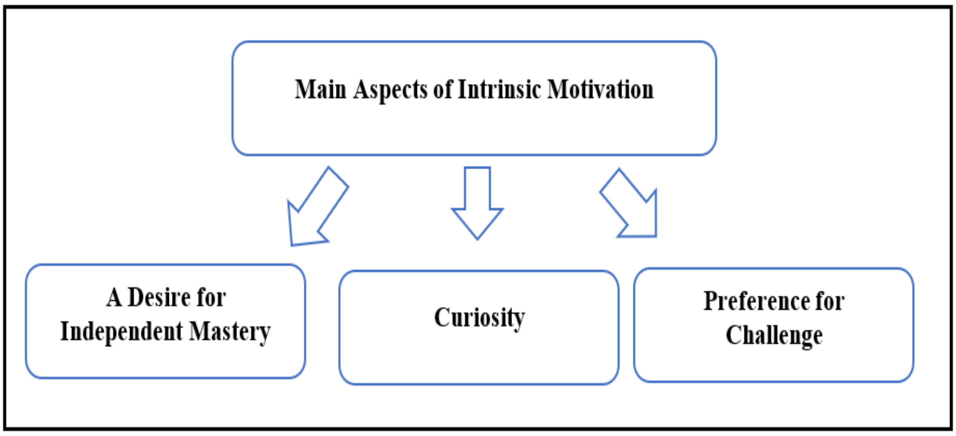

Figure 2. *Main IM Aspects*

Lesson planning is essential for teachers to accomplish their teaching objectives. It assists them in identifying instructional curriculum deficiencies, planning the most appropriate procedures for delivering and assessing lessons, continuously developing their academic and professional experiences, avoiding embarrassing or unanticipated situations, and avoiding arbitrariness and impromptu speaking (Salama, 1996; Zaitoun, 2017). Mastery of such skills necessitates a high level of proficiency in teaching skills, including formulating clear and specific learning objectives, content analysis, managing incremental experiences, and selecting and developing various assessment instruments to measure the attainability of learning objectives. Planning a lesson requires a clear perception of the anticipated learning situation to achieve the objectives, identifying appropriate techniques and activities consistent with the learning situation and the learners' personalities, and specifying appropriate assessment methods (Hatton, Owens, & Powell, 1994). Lesson planning is a mental and written task the teacher performs well before the lesson.

It includes classroom-based actions the teacher performs before interacting with students, such as writing objectives, determining students' schemata, learning tools, lesson steps, relevant students' activities and roles, and the teacher's guidance and motivation techniques for students. Consequently, lesson planning, as the written component of instructional planning, is the appropriate starting point for effective classroom learning actions. It should include several elements and components the instructor has carefully designed to stimulate their and the students' performance toward attaining the intended learning objectives. Similarly, assessing teachers' mastery of these skills is essential to enhance their professional training and orientation programs. Along these lines, this study seeks to identify instructors' actual lesson planning practices.

The purpose of the present study is to examine the influence of science teachers' pedagogical variations (traditional versus flipped learning) on the intrinsic academic motivation (AIM) and lesson planning of science teacher-students in the Postgraduate Professional Teaching Diploma (PPTD) Program at Al Ain University in the United Arab Emirates. This research aims to address the following two concerns. Existe-t-il des écarts statistiquement significative entre les arithmetic means about the AIM for PTTD Science teacher-students about the teaching method (traditional versus flipped learning)? Are there statistically significant differences between the arithmetic means of lesson planning for PTTD Science teacher-students about the teaching method variation (traditional versus flipped learning)?

This research can contribute novel ideas and discoveries to the literature to comprehend the impact of FCM on teacher-student AIM and proper attitude. Moreover, the findings of this study can contribute novel ideas and discoveries to the literature to better comprehend the impact of FCM on lesson planning. Thirdly, it can allow other researchers, particularly those interested in sophisticated technologies, to conduct relevant research. Finally, this investigation's findings can benefit educational universities and institutions abroad.

2. Literature Review

Various relevant studies have linked the FCM strategy to variables such as motivation and accomplishment in science, mathematics, and foreign languages. Still, they have neglected to examine other aspects, such as lesson planning. Alyoussef conducted a study (Alyoussef, 2022) that examined the acceptability of the FCM approach as an instructional strategy and student FCM-related attitudes. The study sought to comprehend the effects of greater technology integration in instruction. The investigation involved a sample of (213) university students from King Faisal University. After one semester of studying in an FCM environment, participants responded to a custom-designed survey regarding their attitude toward additional FCM-consistent instruction. A positive correlation was discovered between independent variables and FCM-consistent attitudes. In addition, a second study (Barrios et al., 2022) investigated the FCM-related perceptions of university students in Barranquilla, Colombia, during the Covid19 pandemic. The research sample consisted of 302 students from various institutions in Barranquilla who participated in FCM-consistent virtual or distance learning courses. During the pandemic, the FCM-consistent strategy increased students' self-perceptions (independent learning), according to the study. In addition, the study found that the FCM-consistent strategy, facilitated by university-applied emerging technologies, enabled students to learn by doing, creating, and sharing rather than memorization (the conventional method).

In addition, several studies have demonstrated a correlation between the FCM-consistent strategy and several variables in various academic subjects, including science, mathematics, and others. Concerning the FCM-consistent strategy in science, Al-Shakaa conducted a study (Al-Shakaa, 2016) titled "The Impact of both Blended Learning and Flipped Learning Strategies on Seventh-Grade Science Achievement and Learning Retention." The study aimed to determine the impact of the FCM-consistent strategy versus the conventional strategy on the Science achievement and retention of seventh-graders. Using a quasi-experimental design, the Science achievement test was administered to 133 sample participants divided into control and experimental groups. According to the study, there were statistically significant differences in favor of the experimental group between the arithmetic means of student ratings. In addition, Ambusaidi and Al-Hosani (2017) conducted a study to determine the impact of FCM-consistent Science instruction on 9th-grade female students' motivation for Science learning and academic achievement. The research sample consisted of fifty-three female students from a primary school in the Oman governorate of Al-Batinah South. The female students who participated were divided into two groups: (27) for the experimental group and (26) for the control group. An FCM-consistent teacher's guide was created for the study. Utilizing the motivation scale to evaluate Science learning. In addition, an examination was administered on the unit of electricity and its technical applications. The study revealed statistically significant differences in favor of the experimental group between the arithmetic means of female students' Science learning motivation and academic achievement scores in the experimental and control groups.

Alwan and Atiyat (2010) investigated the relationship between academic intrinsic motivation and academic achievement for a cohort of 10th graders in the Jordanian city of Ma'an. The sample consisted of (111) male and female pupils, including (62) overachievers and (49) underachievers. The two researchers utilized the advanced academic intrinsic motivation (AIM) scale devised by Lepper (2005). This scale consists of the following primary dimensions: Preference for Challenge, Curiosity, and A Desire for Independent Mastery. The study revealed a statistically significant correlation between students' intrinsic motivation and academic achievement and AIM-related differences between overperformers and underperformers that favored intrinsically motivated students. However, the study revealed no statistically significant gender differences regarding AIM. The purpose of Dhari and Baidaa's (2016) study was to determine the relationship between intrinsic motivation and time management for college students. The sampled students' intrinsic motivation and time management were measured, and fundamental research scores were compiled concerning gender and specialization variables. The study sample included (350) male and female college students, with (230) females and (120) males. Students in the cohort completed measures of intrinsic motivation and time management. The study found statistically significant gender differences in favor of males for intrinsic motivation and time management and statistically significant differences between both study variables.

Saleem (2014) conducted a study to investigate the relationship between intrinsic motivation, on the one hand, and flow experience and academic self-efficacy, on the other, for a sample of high-achieving university students. The research sample consisted of (140) junior (3rd-year) male and female students from the Faculty of Education at Damanhour University in Egypt who had earned excellent grades in all courses over the previous years. The AIM Scale, Flow Experience Scale (Jackson & Eklund, 2002, 2004), and Academic Self-Efficacy Scale (Chemers, Hu, & Garcia, 2001) were utilized in the study. The study employed descriptive correlational methodology. No statistically significant differences in AIM-related specialization were found between males and females or between literary and scientific streams. Tsai et al. (2020) conducted a study to determine the impact of the FCM-consistent brainstorming technique on Physical Education students' learning performance, motivation, teacher-student interaction, and creativity. The research sample included sixty-five students at the preparatory level. Following the quasi-experimental design, the experimental group studied using the FCM-consistent ideation method, whereas the control group received direct instruction. The study discovered that FCM can improve students' performance, motivation, and interactions with their teachers and peers. Less than a handful of studies have been published on lesson preparation and FCM strategy. Nevertheless, there are additional studies on instruction planning.

Omari (2017) conducted a study to analyze the behavior objectives included in lesson planning journals for teachers of grades 1-3 and the respective influencing factors from the perspective of teachers in Irbid Governorate schools. The researcher devised a check list and an open-ended question for the study. The validity and dependability of the tool were demonstrated. A random sample of (649) planning notebooks containing (5172) behavior objectives were collected for the study. The cognitive domain was most prominent in the daily planning notebooks of 1-3 grade teachers, while the affective and skill domains were least prominent. In addition, the study's findings revealed that female instructors outperformed male teachers in formulating behavior objectives. As for the effect of grade, there was a statistically significant difference favoring the cognitive domain at a significance level of 0.01 across all grades. The study recommended that educators receive training and orientation on the correct formulation of educational goals in daily planning notebooks. Tabashi and Mamadi (2011) conducted a study to determine the level of performance of primary-stage instructors in terms of their planning competencies. The descriptive methodology was applied to a sample of (120) male and female educators. The study concluded that the performance of primary school teachers was relatively poor and that the teacher-built planning foundation for the learning process was too flimsy, impeding the development of stable educational foundations. Therefore, the study suggested that instructors should be counseled on the significance of genuine and effective lesson planning and instructed in planning proficiency.

3. Methodology

3.1 Study Approach

This study utilized a quasi-experimental design to investigate the impact of pedagogical variation (traditional versus flipped learning) on the academic intrinsic motivation and lesson planning of PTTD Science teacher-students as correlated dependent variables. Both dependent variables underwent a pre-test and a post-test.

3.2 Study Participants

The sample consisted of eighty-three male and female PTTD Science instructors enrolled at Al Ain University during the first semester of 2022/23. The sample participants were divided into two groups: a control group consisting of (43) teachers (representing 51.8% of the total sample) who received traditional instruction and an experimental group consisting of (40) teachers (representing 48.2% of the total sample) who received FCM-consistent instruction. See Table 1.

Table 1

Tallies, Percentages & Distributions of Students per Teaching Method and Academic Qualification

Group	Frequency (f)	Percentage (%)
Traditional	43	51.8
Flipped	40	48.2
Total	83	100

3.3 Study Tools

3.3.1 Lesson Planning Rubric

The study's researchers devised a lesson planning rubric and lesson planning evaluation tool based on their educational experience. The device contained multiple sections: objectives, content, teaching methodologies and strategies, learning activities, and tools and technologies. Five professional referees (a science educational supervisor, two curriculum & pedagogy faculty members, and two science teachers) reviewed the instrument to attain face validity. Considering the referees' advice, the instrument was modified by reformulating some rubrics and eliminating others. Each of the five sections was awarded twenty (20) points. The cumulative score for the tool was (100) points. The instrument's dependability was demonstrated using the test-retest technique. The instrument was administered to thirty unrepresentative male and female PTTD students. After fifteen days, the instrument was read, and Pearson's correlation coefficient was calculated. It measured 0.84, regarded as acceptable for the study's purpose.

3.3.2 Academic Intrinsic Motivation Scale

The intrinsic academic motivation (AIM) scale, which was initially developed by Lepper (2005) and then Arabized and standardized by Alwan and Atiyat (2010), was used. The AIM scale consists of twenty-four items that measure three motivational dimensions: preference for difficulty, curiosity, and a desire for independent mastery. Each dimension encompasses eight elements. The Likert scale of strong disagreement, disagreement, neutral, agreement, and strong agreement was utilized. The minimum score for each dimension is set to (24), and the maximum score is set to (120). The scale's validity was demonstrated using three coefficients: face validity (as determined by referees), factorial validity, and construct validity (as determined by correlations between subdimensions of the scale). Two coefficients demonstrated the reliability of the scale: internal consistency (Cronbach's Alpha), which was 0.83, and stability consistency (test-retest), which was 0.86. These scale values were regarded as suitable for the study's objectives.

4. Study Findings

The following investigation questions were posed: Are there statistically significant differences between the AIM-related arithmetic means of PTTD science teacher-students about teaching method variation (traditional versus flipped learning)? Statistically significant differences between the arithmetic mean of lesson planning for PTTD Science teacher-students about variation in teaching methodologies (traditional vs. flipped learning) were also investigated.

The research questions comprised one independent variable with two levels (traditional versus flipped learning) and two correlated dependent variables (intrinsic academic motivation and lesson planning). The arithmetic means, and standard deviations were computed for AIM & lesson planning pre- and post-tests for various teaching methods and grade levels. See Table 2.

Table 2

Arithmetic Means & Standard Deviations for Student AIM & Lesson Planning Pre-tests & Protests Per the Teaching Method

	Method	N	Mean	Std. Deviation
Planning	Traditional	43	77.02	6.71
	Flipped	40	80.93	7.56
	Total	83	78.90	7.36
Motivation	Traditional	43	88.40	6.18
	Flipped	40	90.48	6.58
	Total	83	89.40	6.42

Table 2 reveals a variation in the arithmetic means and standard deviations for student AIM and lesson planning based on the instructional strategy. To ascertain the statistical significance of these differences, a multivariate analysis of covariance (MANCOVA) was employed to account for any potential preexisting differences (pre-tests for AIM and lesson planning). Consideration was given to differences between the pre- and post-tests. Table 3 displays the results of the tests.

Table 3

MANCOVA Test Results for Student AIM & Lesson Planning Per the Teaching Method

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared (η2)
Intercept	Pillai's Trace	.513	41.096b	2.000	78.000	.000	.513
	Wilks' Lambda	.487	41.096b	2.000	78.000	.000	.513
	Hotelling's Trace	1.054	41.096b	2.000	78.000	.000	.513
	Roy's Largest Root	1.054	41.096b	2.000	78.000	.000	.513
Pre AIM	Pillai's Trace	.638	68.793b	2.000	78.000	.000	.638
	Wilks' Lambda	.362	68.793b	2.000	78.000	.000	.638
	Hotelling's Trace	1.764	68.793b	2.000	78.000	.000	.638
	Roy's Largest Root	1.764	68.793b	2.000	78.000	.000	.638
Pre LP	Pillai's Trace	.771	131.161b	2.000	78.000	.000	.771
	Wilks' Lambda	.229	131.161b	2.000	78.000	.000	.771
	Hotelling's Trace	3.363	131.161b	2.000	78.000	.000	.771
	Roy's Largest Root	3.363	131.161b	2.000	78.000	.000	.771
Method	Pillai's Trace	.162	7.531b	2.000	78.000	.001	.162
	Wilks' Lambda	.838	7.531b	2.000	78.000	.001	.162
	Hotelling's Trace	.193	7.531b	2.000	78.000	.001	.162
	Roy's Largest Root	.193	7.531b	2.000	78.000	.001	.162

a. Design: Intercept + Post AIM + Post LP + METHOD
b. Exact statistic

Wilk's Lambda = 0.84, F (2, 78.00) =7.31, partial η2 = 0.21, in favor of the FCM-consistent group, demonstrates a statistically significant difference between the Traditional and Flipped learning groups in terms of their scores on Lesson planning. Table 4 displays MANCOVA test results for student intrinsic motivation and lesson planning based on teaching method to determine the source and magnitude of these differences.

Table 4

MANCOVA Test Results for Student AIM & Lesson Planning Per the Teaching Method

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared (η2)
Corrected Model	Post AIM	2168.955a	3	722.985	47.089	.000	.641
	Post LP	3511.889b	3	1170.630	99.726	.000	.791
Intercept	Post AIM	775.395	1	775.395	50.503	.000	.390
	Post LP	400.166	1	400.166	34.090	.000	.301
PRE-AIM	Post AIM	2063.299	1	2063.299	134.386	.000	.630
	Post LP	48.660	1	48.660	4.145	.045	.050
PRE LP	Post AIM	4.646	1	4.646	.303	.584	.004
	Post LP	3110.870	1	3110.870	265.015	.000*	.770
METHOD	Post AIM	7.833	1	7.833	.510	.477	.006
	Post LP	174.100	1	174.100	14.832	.000	.158
Error	Post AIM	1212.925	79	15.353			
	Post LP	927.340	79	11.738			
Total	Post AIM	666712.00	83				
	Post LP	521179.00	83				
Corrected Total	Post AIM	3381.880	82				
	Post LP	4439.229	82				

* statistically significant

Table 4 demonstrates that, at a significance level of α=0.05, there were no statistically significant differences between the AIM arithmetic means based on the instructional method (traditional versus flipped learning). The value represented by F (5.10.1) is not statistically significant. In addition, at a significance level of α=0.05, there were statistically significant differences between the arithmetic means of lesson planning based on the teaching method (traditional versus flexible learning). To determine which teaching method (traditional vs. flipped learning) had a greater statistical effect on lesson planning, we consulted Table 2, which revealed that the arithmetic mean of lesson planning for the traditional learning method was 77.02, and the relevant standard deviation was 7.56. In contrast, the arithmetic mean of lesson planning for flipped learning methods was 80.92, and the corresponding standard deviation was 7.56. Statistical significance (p=.000) indicates that the reversed learning strategy in lesson planning was more effective than the traditional learning strategy.

5. Discussion and Conclusion

This study aimed to examine the effect of teaching method variation (traditional versus flipped learning) on the academic intrinsic motivation and lesson planning of PTTD science teacher-students. On the lesson planning rubric, there were statistically significant differences in favor of FCM-consistent instruction between study groups. These findings align with the recommendations of Omari (2017), which call for preparing and training teachers on the correct educational formulation of daily lesson planning, and with the findings of Tabashi and Mamadi (2011), which emphasize the significance of authentic and good lesson planning for teachers as well as the acquisition of instruction planning competencies by teachers. This positive finding regarding reversed learning is consistent with the results of numerous other studies. FCM-consistent understanding, aided by technology (e.g., videos, websites, etc.), enables students to obtain knowledge visually and aurally more effectively; allows students to repeat the lesson or instruction at their convenience, which accommodates individual differences amongst students; and is more enjoyable than traditional learning, as students remain active and experience prescribed education independently, thereby consolidating their abilities. Similarly, Barrios et al. (2022) noted that flipped learning enables students to learn by doing, by creating, and by sharing, with the aid of emerging technologies deployed by universities.

This study, however, found no statistically significant differences between AIM-related arithmetic means at a significance level of =0.05 about variation in the teaching methodologies (traditional versus flipped learning). In contrast to Al-Hajeri's study (2021), which demonstrated the efficacy of the reversed learning strategy in boosting motivation, this study shows the opposite. Ambusaidi and Al-Hosani (2017) revealed statistically significant differences between the arithmetic means of female students' Science learning motivation scores in the experimental and control groups. Alwan and Atiyat (2010) found statistically significant differences in favor of AIM-driven pupils between overachievers and underachievers. Tsai et al. (2020) concluded that reversed learning could effectively boost students' motivation. These findings demonstrate a correlation between intrinsic motivation and various outcomes, including academic achievement, creativity, comprehension, pleasure, and profound learning strategies. Changing intrinsic motivation, i.e., performing an activity for its inherent value rather than a distinct outcome, requires considerable time. However, lesson planning is primarily a cognitive process that can be improved through frequent practice, particularly independently, as in flipped classrooms.

6. Theoretical and Practical Implications

This research has contributed substantial literature to the corpus of knowledge that was not reported in previous studies. The findings of this study contributed to the literature on the significance of the roles of instructors and students in classroom activities. Furthermore, this study demonstrated that self-motivated teachers must work to achieve their better objectives in flipped classrooms. This study contributed to the literature by showing that intrinsic motivation substantially affects the performance and acceptability of people's cognitive abilities. When students and teachers are intrinsically motivated to attain their academic objectives, their creativity, and performance are more likely to succeed. According to the study, deep learning strategies are statistically related to intrinsic motivation, which is the key to attaining academic objectives. The literature review also revealed that student performance could be improved equitably when intrinsically motivated to accomplish their educational goals. In the meantime, this study contributed to the literature by demonstrating that the flipped class-learning method is superior to the traditional learning method, increasing student performance.

This study also has some practical implications. The findings of this study indicated that students should be rewarded for their exceptional performance and that their overall environment should reflect their caliber. If students were appropriately motivated, they would better comprehend their appropriate implementation. Similarly, teachers are required to implement the new method of instruction because the new strategies are more reasonable and applicable to achieving the objectives of any organization. In addition, when students have a negative attitude toward their performance, their instructors should encourage and develop them. This study emphasized the importance of adopting modern teaching strategies and flipping the classroom to improve student conduct. Students' performance would differ depending on whether they possessed a negative or positive attitude. The accessibility of the students' learning approach can facilitate the development of their working strategies and enhance their academic performance. Teachers with backgrounds in science and languages are required to motivate students to improve their academic performance, which is crucial to attaining their organization's objectives.

7. Limitations and Future Directions

The methodology and findings of this study have some limitations. First, the scope of this study was limited to the FCM on the AIM and lesson planning for science teacher-students. In addition, this study has human limitations because it has only considered PPTD science teacher-students. Thirdly, the geographical scope of this study is restricted to Al Ain University in the United Arab Emirates. Lastly, the current study was time-bound and limited to the first-semester population of the academic year 2022/23. The following recommendations are made for future research in light of the study findings. Future research must introduce and train instructors to implement the flipped learning strategy. Second, future research should include the reversed learning strategy in teacher training and orientation programs. Thirdly, future research is encouraged to consider additional variables. Future research would significantly advance the body of knowledge by focusing on these future directions.

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Availability of data and materials

We would have loved to share the data; however, the data is primary, and the authors do not wish to share the data as this may breach participant confidentiality.

Authors' contributions

All authors were involved in research design, study implementation, data gathering, data analysis, and manuscript writing. All authors approve the submission of the manuscript for publication consideration. All authors read and approved the final manuscript.

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Competing interests

Competing interests As authors, we declare that we have no significant financial, professional, or personal interests that may affect the performance or presentation of the work described in this manuscript. (The authors declare that they have no competing interests).

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