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THE IMPACT OF THE FLIPPED CLASSROOM MODEL (FCM) ON THE ACADEMIC INTRINSIC MOTIVATION (AIM) AND LESSON PLANNING FOR MATHEMATICS TEACHER-STUDENTS IN THE POSTGRADUATE PROFESSIONAL TEACHING DIPLOMA (PPTD) PROGRAM AT AL AIN UNIVERSITY: A CASE STUDY

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ABSTRACT

This study examined the impact of the flipped classroom model (FCM) on Academic Intrinsic Motivation (AIM) and lesson-planning performance among Mathematics teacher-students enrolled in the Postgraduate Professional Teaching Diploma (PPTD) program at Al Ain University, UAE. A quasi-experimental design was used with 87 participants divided into a traditional-instruction control group (n = 43) and an FCM experimental group (n = 44). Data were collected using a lesson planning rubric, a lesson-plan evaluation tool, and an Academic Intrinsic Motivation Scale. Statistical analysis was conducted using SPSS. Findings showed a statistically significant improvement in lesson-planning skills among students exposed to the FCM, indicating that technology-supported, self-paced pre-class preparation enhanced their ability to design effective lessons. However, no significant differences were found between the two groups in AIM scores at the $\alpha = 0.05$ level. The study recommends incorporating flipped learning strategies into teacher-education programs and providing targeted training to mathematics teachers on effective FCM implementation.

KEYWORDS: Flipped Classroom Model, Academic Intrinsic Motivation, Lesson, Postgraduate Professional Teaching Diploma.

1. INTRODUCTION

Due to the fast-growing pace and global ubiquity of scientific inventions, knowledge has considerably and relentlessly swelled up so much so that today's world is now dubbed as the age of Information Revolution and Knowledge Explosion. As a result of the information revolution, human knowledge, essentially science and technology, has doubled and accumulated exponentially. Such changes are deemed major challenges facing educational systems worldwide. Education fundamentally passes down intergenerational legacy and fosters various individuals' growth-grounded intellectual experiences and situations. Given that pedagogy is a pivotal component of the educational process, the various ever-developing fields of knowledge necessarily call for a concomitant growth of instructional methods and techniques. A teacher's well-adopted teaching method can help surmount curricula shortcomings, especially when exceptional and incidental variables cross into the instructional milieu. During the outbreak of the Covid19 pandemic, face-to-face instruction arbitrarily shifted to virtual instruction (Barrios et al., 2022), forcing numerous educational institutions to overhaul available instructional methods. Most face-to-face instructional methods were then mothballed and supplanted by other distance learning ones. The advancement of unorthodox instructional methods, including flipped classrooms, has caught on, even after the subsidence of Covid19 pandemic, owing to educational institutions' overhaul and realignment of instructional methods as well as development and incorporation of up-to-date pro-learning and pro-teaching technologies -including social media, smartphones and tablets- into the educational system (Alyoussef, 2023).

The flipped classroom model (FCM) has been around since 2012 at which time Bergmann and Sams initially called it Flipped Classroom Model or just Flipped Classroom (FC). The term "flipped classroom" is more widely used in primary education in the USA (Awidi & Paynter, 2019), but FCM has recently strongly resurfaced as an appropriate post-Covid19 model. FCM upends the traditional learning conception where academic content is first delivered in classroom settings and then applied at home. FCM, however, reverses the pattern, as learning starts at home through video or other media, and then classroom lessons are devoted to teacher-guided home-initiated individual or group learning activities (alqahtani, et al, 2022; Oyaid & Alshaya, 2020). Correspondingly, the traditional pattern of "classroom listening" and "home problem-solving" (i.e. homework) shifts to "home listening" and "classroom problem-solving" (Meng-Ning et al, 2020).

FCM enables teachers to prioritize active learning during classroom time by assigning learning matter and PPTs that students can engage with at home or outside the classroom, which consequently lessens "home learning" and "home listening" and augments "class work and learning". Thus, FCM renders classroom time more pleasurable, productive and conducive for both students and teachers (Lesley University, 2023). FCM predicates upon the constructivist theory which views learning as an active process and the student as an active and nonpassive learner that constructs knowledge experientially (Al-Hajri, 2021).

FCM is a multistep process (Oyaid & Alshaya, 2020; Shaqlal, 2018; Bergmann & Sams, 2012; Bretzmann, 2013) which can broadly be divided into two primary phases: Home study and Classroom Activities. In Phase One (home study), the teacher sets student objectives and skills, administers preassessment, identifies appropriate content and technology, templatizes content in a digital student-accessible form, assigns inherently practical problem-solving tasks and adopts a formative assessment tool. Students, on the other hand, prepare by viewing a video, listening to a podcast, reading articles, answering questions that probe their knowledge and reflect on learning, as well as recording and sharing inquiries through prespecified teacher-student communication media. Eventually, the teacher reviews learners' pre-lesson written work, and then categorizes and designs academic content based on learners' inquiries. In Phase Two (classroom activities), abiding by the constructivist theory which hinges upon making inquiries, seeking answers and solving problems; the teacher raises the questions or problems while learners collectively search for answers and solutions. At this stage, the teacher just listens to ongoing learner-to-learner conversations and gives guidance and assistance as needed.

Notably, the teacher's role as the leader, basis and centre of the learning process pivots to an active member guiding, directing and stimulating a group of learners as well as helping them to overcome obstacles and promoting their self-learning skills. Concomitantly, the learners' previous role as passive recipients of knowledge is transformed into learners efficiently in charge of and guiding their learning experience and actively applying and exploring their newly-acquired knowledge.

1.1 FCM: Positives & Negatives

FCM-related positives comprise the following (Oyaid & Alshaya, 2020**;** Al-Hajeri ؛2021 ،Alyoussef,

2020; Ruiz-Jim´enez et al., 2022; Meng-Ning et al, 2020; MC Ruiz-Jim´enez, 2022, et al): it enables learners to repeat the lesson pursuant to their individual differences and comprehension abilities; it enables the teacher to utilize class time for guidance, stimulation and assistance; it allows for stronger teacher-learner rapport; it fosters prudent use of advanced educational technology; it transforms the learner into an active student searching their sources of knowledge; it promotes critical thinking, self-learning, as well as communication and cooperation skills; and it warrants best and optimal employment of class time. At the other end of the scale, FCM-related negatives comprise the following: it is time-consuming and demanding for teachers, as lesson planning calls for meticulous academic content preparation; and it requires that teachers develop additional technical skills such as production and editing of videos and animations. Research shows that only half of the teachers can demonstrate necessary FCM development capabilities (Alyoussef, 2023). Besides, FCM success is contingent upon learners' enthusiasm and motivation (Ruiz-Jim´enez, et al., 2022). The teacher-adopted instructional strategy and classroom management catalyze students' learning motivation (Al-Zubi & Toq. 2020). For learning to take place, learners must first have a motive. Shorn of motivation, learning could not occur as there is no learning behaviour; motivation causes behaviour (Phillips & More, 2022), and hence the significance of motivation for causing learning.

1.2 Intrinsic Motivation

Motives can categorically be either physiological and psychological or intrinsic and extrinsic. Intrinsic motivation is an inner force that drives the learners towards the activity, cultivating perseverance and persistence to achieve the objective without external rewards. Intrinsic motivation correlates with several positive school outcomes including academic achievement, creativity, comprehension, satisfaction along with deep learning strategies (Corpus, McClintic-Gilbert, and Hayenga, 2009). Intrinsic motivation can be defined as a desire to do a task solely for its inherent characteristics (Stokes-Zoota, 2000). Relatedly, academic intrinsic motivation (AIM) refers to doing an activity for its own merits rather than for any separable consequence (Lepper, 2005).

Therefore, in order to facilitate the attainment of projected educational objectives, the teacher should promote students' intrinsic motivation for learning. Unlike intrinsic motivation, extrinsic motivation revolves around using rewards; self-motivation appertains to enjoyment derived from doing tasks. Motivation for learning is definitionally manifested by the sort of cognitive engagement exhibited by the student during learning tasks and activities (Al-Zubi & Toq, 2020).

There are several aspects of AIM-related learning stimuli, as shown in Figure 1 (Lepper, Corpus, & Iyengar, 2005):

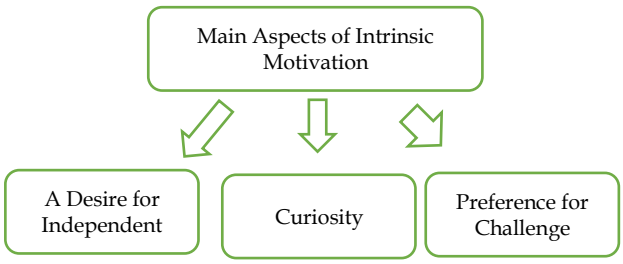

Figure 1: Main Aspects of Intrinsic Motivation

1.3 Lesson planning

Lesson planning is an essential step underlying teachers' successful achievement of teaching objectives. It helps them discover instructional curriculum deficiencies, plan best relevant procedures to deliver and assess lessons, continually develop their academic and professional experiences, avoid embarrassing or unanticipated situations, and steer away from arbitrariness and extemporaneity (Salama, 1996; Badawi, 2003; Zaitoun, 2017). Mastery of such skills requires ample proficiency in teaching skills, including formulation of clear and specific learning objectives, content analysis, management of incremental experiences, as well as selection and development of various assessment tools to gauge the achievability of learning objectives. Lesson planning entails a clear perception of the forecast learning situation to achieve the objectives; the identification of appropriate techniques and activities consistent with the learning situation and the learners' characters; and particularization of suitable assessment methods.

Lesson planning is a mental and written task carried out by the teacher well in advance of the lesson (Hatton et al., 1994). It covers different components to achieve set objectives including classroom-based actions which the teacher does before engaging with students, such as writing objectives as well as determining students' schemata, learning tools, lesson steps, relevant students' activities and roles, and the teacher's guidance and motivation methods for students.

Accordingly, lesson planning, being the written aspect of instructional planning, is the right starting point for successful learning action inside the classroom. It should contain several elements and

components devised well by the teacher to activate their and the students' performance towards the attainment of projected learning objectives. By the same token, it is important to determine teachers' mastery of these skills with a view to improving teachers' professional training and orientation programs. Along these lines, this study attempts to identify the reality of teachers' lesson planning practice.

1.4 Study Goals

The current study aims to investigate the impact of Mathematics teachers' pedagogical variations (traditional vs. flipped learning) on the academic intrinsic motivation (AIM) and lesson planning for Mathematics teacher-students in the Postgraduate Professional Teaching Diploma (PPTD) Program at Al Ain University in the United Arab Emirates.

1.5 Study Questions

The study attempts to answer the following two questions:

1. Are there any statistically significant differences between AIM-related arithmetic means for PPTD Mathematics teacher-students relevant to variation of teaching methods (traditional vs. flipped learning)?
2. Are there any statistically significant differences between the arithmetic means of lesson planning for PPTD Mathematics teacher-students relevant to variation of teaching methods (traditional vs. flipped learning)?

1.6 Significance of the Study

- Research findings can add novel ideas and discoveries to literature to understand FCM impact on teacher-students' AIM and relevant attitude.
- Research findings can add novel ideas and discoveries to literature to understand FCM impact on lesson planning.
- It can open the door for other researchers, especially those interested in advanced technologies, to conduct germane studies.
- Research discoveries can be valuable for educational universities and institutions abroad.

3. Literature Review

Different germane studies have linked the FCM strategy with several variables such as motivation and achievement in Science, Math and Languages, but they have failed to cover other aspects such as lesson planning. Addressing the acceptability of the FCM approach as an instructional strategy and student FCM-related attitudes, Alyoussef conducted a study (Alyoussef, 2023) that aimed to understand the effects of greater technology infusion in instruction. A sample of (213) university students from King Faisal University participated in the study. After studying in an FCM setting for one semester, participants responded to a custom-designed poll about their attitude towards further FCM-consistent instruction following the experiment. The study found a positive correlation between independent variables and FCM-consistent attitudes. Moreover, another study (Barrios et al., 2022) aimed to explore the FCM-related perceptions of university students in Barranquilla in Colombia during the Covid19 pandemic. The study sample consisted of (302) students from different Barranquilla-based universities taking either virtual or distance learning FCM-consistent lessons. The study found that the FCM-consistent strategy benefited students because it increased their self-perceptions (independent learning) during the pandemic. Besides, the study found that the FCM-consistent strategy, aided by university-applied emerging technologies, allowed for learning by doing, by developing and by sharing rather than by memorizing (traditional method).

Furthermore, some studies have linked between the FCM-consistent strategy and several variables in different school subjects such as Science, Math as well as others. Concerning the use of the FCM-consistent strategy in Science, Al-Shakaa made a study (Al-Shakaa, 2016) entitled "The Impact of both Blended Learning and Flipped Learning Strategies on 7-graders' Science Achievement and Learning Retention". The study aimed to identify the effect of the FCM-consistent strategy, as compared with the traditional strategy, on 7-graders' Science achievement and learning retention. Employing the quasi-experimental approach, the study administered the Science achievement test to the (133) sample participants who had been divided into a control group and an experimental group. The study found that there were statistically significant differences in favour of the experimental group between the arithmetic means of student scores. To add, Ambusaidi and Al-Hosani (2018) conducted a study aiming to investigate the effect of FCM-consistent Science instruction on developing motivation for Science learning and academic achievement of female 9-graders. The study sample comprised (53) female students from a primary school located in Al-Batinah South Governorate in Oman. The participating female students were divided into two groups: (27) for the experimental group; (26) for the control group. For the purpose of the study, a FCM-consistent teacher guide

was prepared. The motivation scale was used to measure Science learning. An achievement test on the unit of electricity and its technical applications was also used. The study showed that there were statistically significant differences in favour of the experimental group between the arithmetic means of female students' scores in the experimental and control groups pursuant to Science learning motivation and academic achievement.

Regarding motivation, Alwan and Atiyat (2010) carried out a study to investigate the correlation between academic intrinsic and academic achievement for a sample of 10-graders in the city of Ma'an in Jordan. The sample comprised (111) male and female students including (62) overperforming students and (49) underperforming students. For the purpose of the study, the two researchers employed the advanced academic intrinsic motivation (AIM) scale, developed by Lepper (2005), consisting of the following main dimensions: Preference for Challenge, Curiosity and A Desire for Independent Mastery. The study revealed that there was a statistically significant correlation between students' intrinsic motivation and academic achievement, and that there were AIM-related differences in favour of intrinsically motivated students between overperformers and underperformers. However, the study showed no statistically significant AIM-related differences between males and females. Dhari and Baidaa (2016) conducted a study whose aim was to determine the relationship between intrinsic motivation and time management for university students. The sampled students' intrinsic motivation and time management were scaled and basic research scores were collated relevant to gender and specialization variables. The study sample comprised (350) male and female students including (230) females and (120) males. The sampled students attempted the intrinsic motivation and time management scales. The study concluded that there were statistically significant gender-based differences in favour of the males for intrinsic motivation and time management, and that there was a statistically significant difference between both study variables.

Saleem (2014) made a study aiming to examine the relationship between intrinsic motivation, on the one hand, and flow experience and academic self-efficacy, on the other, for a sample of academically high-performing university students. The study sample comprised (140) male and female junior (3rd-year) students from the Faculty of Education at Damanhour University in Egypt attaining very good and excellent ratings in all courses over the previous years. The study employed the AIM Scale (French & Dakes, 2003), Flow Experience Scale (Jackson and Eklund, 2002-2004), as well as the Academic Self-Efficacy Scale (Hu and Garcia, 2001). The study used the descriptive correlational approach. Study findings indicated no statistically significant AIM-related specialization-based differences between males and females and between literary and scientific streams. Meng-Ning et al (2020) made a study that aimed to explore the impact of the FCM-consistent brainstorming technique on students' learning performance, motivation, teacher-student interaction and creativity in the Physical Education class. The study sample comprised (65) preparatory stage students. Abiding by the quasi-experimental approach, the experimental group studied using the FCM-consistent brainstorming method; the control group, however, underwent direct instruction. The study found that FCM could effectively enhance students' performance, motivation as well as interaction with the teacher and peers.

There has been an extreme dearth of published studies addressing lesson planning and FCM strategy. Nonetheless, there are other studies that focus on lesson planning. Al-Omari (2017) carried out a study aiming to analyze behaviour objectives incorporated into lesson planning notebooks for 1-3 grade teachers and the respective influencing factors from the point of view of teachers at Irbid Governorate schools. For the purpose of the study, the researcher designed a checklist and an open question. The validity and reliability of the tool were proven. A random study sample, which comprised (649) planning notebooks containing (5172) behaviour objectives, was taken. Study findings showed that the cognitive domain featured the highest in daily planning notebooks of 1-3 grade teachers, while the affective and skill domains featured the lowest. Moreover, study findings revealed that female teachers outperformed male teachers in connection with the formulation of behaviour objectives. As for the effect of the grade variable, there was a statistically significant difference standing at a significant level of 0.01 in favour of the cognitive domain across all grades. The study recommended that teachers should undergo training and orientation on proper educational formulation of objectives in daily planning notebooks. Tabashi & Mamadi (2011) conducted a study that aimed to identify the performance level of primary stage teachers on planning competencies. The study sample comprised (120) male and female teachers and it employed the descriptive approach. The study concluded that the performance of primary stage teachers was fairly low and that the teacher-built planning foundation for the learning process was too fragile, stymieing the construction of solid educational grounds. Therefore, the study proposed that teachers should be counselled on the

importance of genuine and good lesson planning and taking planning proficiency training courses.

3. Methodology

3.1 Study Approach

This study adopted the quasi-experimental approach to examine the impact of pedagogical variation (traditional vs. flipped learning) on academic intrinsic motivation and lesson planning, as correlated dependent variables, of PPTD Mathematics teacher-students. A pretest and posttest were done for both dependent variables.

3.2 Study Participants

The research sample included (87) male and female PPTD Mathematics teachers studying at Al Ain University during the first semester of 2022/2023. The sample participants were divided into two groups: a control group, comprising (43) teachers and accounting for (49.4%) of the total sample, that underwent traditional instruction; & an experimental group, comprising (44) teachers and accounting for (50.6%) of the total sample, that underwent 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	49.4
Flipped	44	50.6
Total	87	100

3.3 Study Tools

3.3.1 Lesson Planning Rubric

Drawing on their educational experience, the study researchers designed a lesson planning rubric and lesson planning evaluation tool. The tool comprehended several sections, namely objectives, content, teaching methods & strategies, learning activities as well as tools & technologies. To achieve face validity, the tool was reviewed by five professional referees (including a Mathematics educational supervisor, two curriculum & pedagogy faculty members & two Mathematics teachers). Considering the referees' counsel, the tool was modified by reformulating some rubrics and omitting some others. A score of (20) marks was given to each of the five sections. The total tool score was (100) marks. The tool reliability was proven based on the test-retest method. The tool was administered to (30) unsampled male and female PPTD students. (15) days later, the tool was readministered and Pearson's correlation coefficient was accordingly measured. It stood at (0.84), which was deemed an acceptable value for the purpose of the study.

3.3.2 Academic Intrinsic Motivation Scale

The academic intrinsic motivation (AIM) scale, originally devised by Lepper (2005) and later Arabized and standardized by Alon & Atiyat (2010), was employed. The AIM scale comprises (24) items measuring three motivation dimensions: Preference for Challenge, Curiosity & a Desire for Independent Mastery. Each dimension covers (8) items. The 5-point Likert scale: Strongly disagree, Disagree, Neutral, Agree, & Strongly agree; was used. For each dimension, the lowest score is set at (24) and the highest score is set at (120). The validity of the scale was proven on three coefficients: face validity (by referees), factorial validity and construct validity (by correlations between scale subdimensions). The reliability of the scale was proven on two coefficients: internal consistency (Cronbach's Alpha), standing at (0.83), & stability consistency (test-retest), standing at (0.86). Those scale values were deemed acceptable for the purpose the study.

4. Study Findings

The study questions were as follows:

1. Are there any statistically significant differences between AIM-related arithmetic means for PPTD Mathematics teacher-students relevant to variation of teaching methods (traditional vs. flipped learning)?
2. Are there any statistically significant differences between the arithmetic means of lesson planning for PPTD Mathematics teacher-students relevant to variation of teaching methods (traditional vs. flipped learning)?

Study questions contained one independent variable for two levels: teaching method (traditional vs. flipped learning), and two correlated dependent variables: (academic intrinsic motivation & lesson planning). Arithmetic means and standard deviations were calculated for AIM & lesson planning pretests and posttests for different levels of teaching methods. See Table (2).

Table (2): Arithmetic Means & Standard Deviations for Student AIM & Lesson Planning Pretests & Protests Per the Teaching Method

	Method	**N**	**Mean**	**Std. Deviation**
Planning	Traditional	43	77.44	5.98
	Flipped	44	82.41	6.81
	Total	87	79.95	6.85
Motivation	Traditional	43	88.42	5.84
	Flipped	44	90.52	6.35
	Total	87	89.48	6.16

Table (2) reveals an apparent variation in arithmetic means and standard deviations for student AIM and lesson planning according to the teaching method. To determine the statistical significance of those differences, the multivariate analysis of covariance (MANCOVA) was used to account for any potentially preexisting differences (AIM & lesson planning pretests). Pretest and posttest differences were taken into consideration. Table (3) shows test results.

Table (3): MANCOVA Test Results for Student AIM & Lesson Planning Per the Teaching Method

Partial Eta Squared (η2)	Sig.	Error df	Hypothesis df	F	Value		Effect
.571	.000	82.000	2.000	54.500[b]	.571	Pillai's Trace	Intercept
.571	.000	82.000	2.000	54.500[b]	.429	Wilks' Lambda	
.571	.000	82.000	2.000	54.500[b]	1.329	Hotelling's Trace	
.571	.000	82.000	2.000	54.500[b]	1.329	Roy's Largest Root	
.617	.000	82.000	2.000	65.919[b]	.617	Pillai's Trace	Pre AIM
.617	.000	82.000	2.000	65.919[b]	.383	Wilks' Lambda	
.617	.000	82.000	2.000	65.919[b]	1.608	Hotelling's Trace	
.617	.000	82.000	2.000	65.919[b]	1.608	Roy's Largest Root	
.658	.000	82.000	2.000	78.719[b]	.658	Pillai's Trace	Pre LP
.658	.000	82.000	2.000	78.719[b]	.342	Wilks' Lambda	
.658	.000	82.000	2.000	78.719[b]	1.920	Hotelling's Trace	
.658	.000	82.000	2.000	78.719[b]	1.920	Roy's Largest Root	
.235	.000	82.000	2.000	12.562[b]	.235	Pillai's Trace	Method
.235	.000	82.000	2.000	12.562[b]	.765	Wilks' Lambda	
.235	.000	82.000	2.000	12.562[b]	.306	Hotelling's Trace	
.235	.000	82.000	2.000	12.562[b]	.306	Roy's Largest Root	

a. Design: Intercept + AIM_POST + LP_POST + METHOD
b. Exact statistic

Table (3) shows a significant difference between students' groups (Traditional and Flipped learning) regarding their scores on Lesson planning, Wilk's Lambda = 0.77, F(2, 82.00)=12.56, partial $\eta^2 = 0.24$, in favour of the FCM-consistent group. Table 3: MANOVA results showing a significant difference between traditional and flipped-learning groups. A lower Wilks' Lambda value indicates the groups differ on the combined dependent variables. The significant F-value confirms that the difference is statistically meaningful, and the partial eta² value (0.24) shows a large effect size, indicating that flipped learning had a substantial positive impact on lesson-planning scores.

To determine the source and level of those differences, Table (4) shows MANCOVA test results for student intrinsic motivation and lesson planning according to the teaching method.

Table (4): MANCOVA Test Results for Student AIM & Lesson Planning Per the Teaching Method

Partial Eta Squared (η2)	Sig.	F	Mean Square	df	Type III Sum of Squares	Dependent Variable	Source
.706	.000	66.396	949.118	3	2847.354	LP_POST	Corrected Model
.630	.000	47.050	684.647	3	2053.942	AIM_POST	
.318	.000	38.714	553.400	1	553.400	LP_POST	Intercept
.405	.000	56.412	820.884	1	820.884	AIM_POST	
.022	.173	1.893	27.053	1	27.053	LP_POST	Pre AIM
.616	.000	133.387	1941.001	1	1941.001	AIM_POST	
.655	.000	157.876	2256.799	1	2256.799	LP_POST	Pre LP
.004	.584	.301	4.386	1	4.386	AIM_POST	
.217	.000*	22.997	328.739	1	328.739	LP_POST	METHOD
.009	.384	.766	11.141	1	11.141	AIM_POST	
			14.295	83	1186.462	LP_POST	Error
			14.552	83	1207.783	AIM_POST	
				87	560194.000	LP_POST	Total
				87	699885.000	AIM_POST	
				86	4033.816	PLAN_POST	Corrected Total
				86	3261.724	AIM_POST	

* statistically significant

Table 4 shows that there were no statistically significant differences between the two groups on the AIM scores ($\alpha = 0.05$), indicating that teaching method did not influence students' achievement in

this area. However, significant differences were found in lesson-planning scores. The flipped-learning group scored higher (M = 82.41, SD = 6.85) than the traditional-learning group (M = 77.44, SD = 5.98), and this difference was statistically significant ($p < .001$). This result indicates that the flipped learning method had a stronger positive effect on students' lesson-planning skills compared with the traditional method.

5. Discussion

The study investigated how traditional and flipped learning methods influence PPTD mathematics teacher-students' intrinsic motivation and lesson-planning performance. Results showed a significant advantage for the flipped classroom model (FCM) in lesson-planning skills, which aligns with Al-Omari (2017) and Tabashi & Mamadi (2011), who emphasized the need for structured teacher preparation in designing effective daily lesson plans. These findings also support research such as Alyoussef (2023) and Barrios et al. (2022), demonstrating that flipped learning—supported by videos, digital platforms, and interactive tasks—enables students to learn at their own pace, remain active during sessions, and develop higher-order thinking skills.

However, no significant differences were found in academic intrinsic motivation between the two teaching methods. This contrasts with studies like Al-Hajeri (2021) and Meng-Ning et al. (2020), which reported motivational gains from flipped learning, yet aligns partially with research suggesting that intrinsic motivation is influenced by broader personal and contextual factors that develop slowly over time. In contrast, lesson planning is a cognitive and procedural skill that responds more rapidly to structured practice, as provided in flipped environments.

Implications for practice:

These findings suggest that universities and teacher-education programs can leverage the FCM to strengthen pre-service teachers' planning competencies by incorporating structured, technology-supported materials and opportunities for independent practice. Integrating FCM-based training modules, video-supported micro-teaching tasks, and guided lesson-planning workshops can help future teachers build stronger instructional design skills, even if motivational changes may require longer-term interventions and supportive learning environments.

6. Recommendations

Considering study findings, researchers recommend the following:

- To introduce the flipped learning strategy into the field and to train teachers on how it can be applied
- To incorporate the flipped learning strategy into teachers' training and orientation programs
- To conduct further studies tackling additional variables

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