

The Impact of Flipped Classroom on Student Learning in Higher Education Institutions in the Middle East

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Abstract

This research examines how flipped classroom (FC) instruction affects the academic results of university students throughout the Middle East. FC teaching pedagogy is one of the relatively new innovative teaching pedagogies that have benefited from the latest technological advancements and emerged as a potential replacement for traditional classroom teaching pedagogies. Based on activity theory, this investigation used two sections from a human-computer interaction course in the Computer Information Sciences department to conduct its quasi-experimental research design. The research included one traditional teaching approach alongside an FC methodology. The assessment of student achievement relied on moderated examinations that measured individual Course Learning Outcomes (CLOs). The research shows that students who learned through an FC approach achieved better results than traditional education methods ($p = 0.007$), scoring 81.25 on average versus 74.25, respectively. Scores measuring CLO3 (81.25) in the FC group exceeded those of CLO2 (79.85) with statistical significance ($p = 0.011$). The traditional section showed no meaningful differences between CLO2 and CLO3 results. The study demonstrates that FC tools, student-centered activities, and educational technology mediate student learning outcomes. The research demonstrates that FC pedagogies offer superior results to traditional teaching models by enhancing student learning achievements and study participation. The research provides essential quantitative findings supporting FC integration within Middle Eastern higher education institutions.

Keywords: Activity Theory, Teaching Pedagogies, Flipped Classroom, Higher Education, Traditional Education.

Introduction

Local and international accreditation commissions constantly pressure Higher Education Institutions (HEIs) in the Middle East to improve student learning outcomes in communications, problem-solving, and ability to function on multidisciplinary teams [2]. Recent research has been criticized for being overly focused on assessing these outcomes solely for accreditation purposes. The alternative is to take a broader holistic view of the student learning outcomes and that the achievement of these outcomes is contingent on the selection of teaching pedagogies that are effective in equipping students with the skills and attitudes specified in those outcomes [3]. Middle East HEIs have realized that using traditional teaching pedagogies such as informative lectures and traditional assessments with closed question types will not be enough to address the accreditation commissions' demands. They embed innovative teaching approaches in their strategic plans to address that shortage. Flipped Classroom (FC) is one of these new innovative teaching pedagogies HEIs strive to implement to address that shortage [4]. The FC model is based on the inverted classroom Yarbrow *et al.* model, where subject matter knowledge is learned outside the classroom using technology, and in-class meetings are used for active learning experiences [5]. Considering that many researchers have argued that FC teaching pedagogy can be much more effective than traditional informative lectures, the executives of Middle East HEIs are encouraging faculty to explore the impact of FC on student learning outcomes [6-8].

One public institution has adopted a new strategic plan with Hybrid Collaborative Teaching (HCT) 2.0 to ensure student-centred learning by blending traditional and innovative technological teaching pedagogies [9]. To implement a new strategic plan, the Computer Information Science (CIS) department faculty were encouraged to explore innovative teaching pedagogies and investigate their impact on student learning outcomes. This is the first research in the CIS department that delves into the FC potentials to examine their impact on students' learning outcomes. This research paper contributes to the second goal of the institution's strategic plan, which is to "Blended traditional and innovative teaching methods to ensure student-centered learning" [9] by first introducing

FC in regular classrooms as a new innovative teaching method and second by exploring the mediating potentials of FC on students learning outcomes.

The relationship between student learning outcomes and FC teaching pedagogy, including the technology used, is beginning to be explored in the literature [10]. However, there is a clear need for a theoretical framework to understand better how FC teaching pedagogy and its technology impact student learning. The overarching question of this study is to investigate how the FC teaching pedagogy mediates the relationship between learners and their learning outcomes. A quasi-experimental research design was used, and a theoretical framework was developed using activity theory. Data was obtained from students' grades in two identical sections of the same Human-Computer Interaction course, where one section was taught using traditional classroom pedagogy and the other was taught using FC pedagogy. Comparing students' performance in these two sections will help explore the mediating role of FC teaching pedagogy between learners and learning outcomes.

The FC teaching pedagogy is one of those new pedagogies receiving increased attention from researchers and practitioners [11]. However, a significant portion of the previous research on FC focused on the types of in-class and out-of-class activities, frameworks used to evaluate the studies, and the methodological characteristics of each study. It mainly focused on students and faculty's perceptions [12, 13]. While few studies reported anecdotal evidence suggesting that student learning is improved in FC compared to traditional classrooms, very little research investigated student learning outcomes objectively. Scholars have recommended that further work is needed to objectively investigate student learning outcomes using controlled experiments or quasi-experimental designs [14, 15]. Considering the mounting pressure on my college from accreditation commissions, increasing tuition costs, free online courses, competition, and reduced budget, the issue of ascertaining the impact of FC teaching pedagogy on student learning outcomes merits special attention.

The research explores FC pedagogy as it mediates students and learning results and assesses its effect on CIS department student achievement. Through the application of activity theory, the research analyzes the mutual effect of tools, rules, and community structures on learning outcomes. The study addresses a significant research void by delivering quantitative findings from Middle Eastern higher education that lacks studies about FC's effects on student cognition. The research aligns itself with institutional strategic goals at HCT while advancing international discussions about innovative teaching approaches to benefit educational policymaking and teaching practice.

1. Literature Review

This literature review aims to provide an overview of the impact of technology on teaching pedagogies and its related effect on student learning outcomes. It also aims to provide a brief overview of the relevant research on the emergence of the FC in HEIs and its links to pedagogy and learning outcomes. The literature review is organized as follows:

1.1. Technology and teaching pedagogies

The rise of technology over the last 25 years has significantly changed teaching and learning in higher education institutions [16-18]. In conjunction with that, a body of literature focused on finding innovative approaches to integrate technology into education [19]. However, there has been a shift in recent literature away from a strong focus on technology integration and its opportunities to a focus on technology as an enabler for innovative new teaching pedagogies and how those technologies can support teaching and learning [20, 21].

Ertmer *et al.* are among the scholars calling for this focus shift from technology integration to technology-enabled learning [22]. The authors stated that for the last 30 years, educators and researchers have been striving to achieve meaningful technology use. However, regardless of the significant investments in educational technologies, there are few assurances that educators are using technology for teaching and learning.

De Koster *et al.* argued for the same shift but recommended a concept-guided development of a technology approach to achieve technology-enabled learning [23]. Whether a new authentic technology-enabled learning environment [22] or a concept-guided approach [23], technology plays a vital role in enabling new teaching pedagogies that significantly impact teaching and learning.

Recent scholarship emphasizes that technology must enable pedagogical innovation rather than serve as a substitute for content delivery. This aligns with Vongkulluksn *et al.* (2023), who argue that value-driven adoption—rather than mere access—predicts meaningful integration in classrooms.

1.2. Flipped classroom and its effectiveness

The FC is a teaching pedagogy in which the learning content is not presented during classroom time; students learn the content before classroom meetings [24]. The FC pedagogy consists of two stages. The first stage is the pre-class learning stage, where students learn the subject knowledge on their own and outside classroom time using material prepared by their teachers. The second stage is in the classroom, where instructors use student-centered active learning activities [25, 26]. Technology has enabled new tools for both stages. Instead of using text-based material or pre-recorded commercial videos, technology has enabled various new media formats that teachers can use to record videos or podcasts and publish them online for their students using different learning management systems [27]. A few examples of these tools are Jing by TechSmith [28], CamStudio by RenderSoft [29], and Screen-O-Matic by ScreenOMatic [30].

The effectiveness of FC in terms of their capacity to improve students' overall motivation, improve students' higher-order thinking skills, and improve students' collaborative learning has been repeatedly investigated in both research and practical studies [31-33]. However, most of these studies are based on students' self-reporting data on their experiences, attitudes, and perceptions. Research on the FC capacity to improve students' cognitive learning outcomes is still lacking [34, 35].

Recent studies have begun to address this gap through experimental and meta-analytic research. For instance, a 2024 experimental study by Köhl et al. demonstrated that flipping without in-class enrichment still significantly improved knowledge retention and metacognitive awareness among psychology students [Köhl et al., 2024]. Similarly, a 2022 meta-analysis by Kapur et al. reviewed 173 flipped-classroom studies and proposed a structured framework—Fail, Flip, Fix, and Feed—emphasizing the need for meaningful in-class activities to maximize flipped learning's impact [Kapur et al., 2022]. These findings reinforce the importance of thoughtful instructional design in FC environments.

1.3. Flipped classroom in HEIs in the Middle East

There is consensus among researchers that FC pedagogy has emerged from K-12 education [37]. O'Flaherty and Phillips *et al.* investigated the reasons for this emergence by conducting a comprehensive overview of the literature on HEIs. They concluded that the increased pressure to promote student-centered learning and increase student satisfaction, student retention, and competition were among the main reasons HEIs promote FC pedagogies in their institutions [11]. However, a review of previous studies on FC in HEIs by Chen *et al.* concluded that FC in HEIs is still underutilized and underexplored [27]. The authors stated that both research and design models on FC in HEIs are insufficient. In line with the findings about the effectiveness of FC in the section above, most of the limited research conducted on FC in HEIs has focused on students' and instructors' experiences, while very few focused on students' cognitive learning outcomes. For example, Gilboy *et al.* conducted a qualitative study on HEIs to describe students' perceptions on FC [10].

Another example is the study conducted by Hao *et al.* about undergraduate students' perspectives on FC [6]. Many other qualitative studies are listed by O'Flaherty and Phillips *et al.* [11]. On the other hand, very few studies on FC in HEIs were of quantitative design that focused on student cognitive learning outcomes. For example, Bradford *et al.* experimented by implementing FC pedagogy in a first-year undergraduate mathematics course. Bradford *et al.* concluded that, on average, students performed better in assessments for topics taught using the FC pedagogy [38].

The usage of FC teaching pedagogy in HEIs in the Middle East is still in its early stages [39]. However, the past two years have seen a growing number of studies in the region exploring flipped learning in practical disciplines. For example, a 2024 quasi-experimental study in Ethiopian HEIs showed significant gains in student participation and satisfaction using flipped methods in health education courses [Ayele et al., 2024]. Similarly, a gamified FC model implemented in 2025 in a Middle Eastern engineering program led to stronger conceptual understanding and reduced misconceptions across cohorts [Al-Khateeb et al., 2025].

Regardless of the continuous significant investment of Middle Eastern HEIs in educational technologies, most studies and applications focused on integrating these technologies rather than on the role of technology as an enabler for innovative new teaching pedagogies [40]. For example, Gouia-Zarrad *et al.* investigated undergraduate first-year Calculus students' attitudes to FC pedagogy at the American University of Sharjah in the Middle East [41]. The authors concluded that most of the surveyed students embraced the FC experiences, and in particular, they enjoyed the student-centered activities in the classroom more.

1.4. Challenges of the flipped classroom

While the most frequently reported advantage of FC pedagogy is providing instructors with the opportunity to use classroom meeting times for student-centered activities versus spending the same time on traditional lecturing, this does not come without a cost [7]. Most of the challenges of the FC pedagogy are in the first stage of this model [42]. These challenges are related to out-of-class activities and mainly to inadequate student preparation before stage 2. For example, low self-regulated behavior by some students was reported by [8]. Failure of some students to acquire the out-of-class learning content is another challenge reported by Lai & Hwang *et al.* [43]. The cultural learning background of the student as a non-independent learner is another challenge reported by Gouia-Zarrad *et al.* [41] in their study about FC pedagogy in HEIs in the Middle East. The challenges are not only related to students; redesigning courses requires more time from instructors to develop FC courses, which Schlairet *et al.* reported as a further challenge [44].

Moreover, recent literature points out that the success of flipped learning depends not just on format but on **pedagogical alignment**. Kapur *et al.* (2022) emphasized that merely reversing content delivery without structured feedback or application leads to limited gains. Additionally, the effectiveness of flipped learning differs by discipline, requiring tailored strategies for content-heavy vs. application-based courses [Al-Samarraie *et al.*, 2023].

These are some of the main challenges that should be considered for further investigation in future research about FC pedagogy.

This literature review highlighted the lack of quantitative experimental studies about the impact of FC teaching pedagogy on students' cognitive learning outcomes in HEIs in the Middle East. This quantitative quasi-experimental study in one of the reputable HEIs in the Middle East will be a step towards filling this gap.

2. Theoretical Framework

Activity theory (AT) provides an appropriate framework to investigate the way an innovative teaching pedagogy (in this case, FC teaching pedagogy) with its technological tools mediates between the subject (in this case, it is students) and the object (the effectiveness of FC learning pedagogy represented by improving student learning outcomes). AT is a theoretical framework that analyzes and understands human interaction using tools and artefacts [45]. AT is mainly relevant for processes undergoing rapid and constant change. The origin of AT can be traced to Vygotsky, Lurija, Rubinstein, and Leontev in the 1930s [46], where cultural tools mediate the interaction between a human individual and surrounding objects. Social and contextual dimensions were added later by the Finnish scholar Engestrom [47]. The extended complex model of Engestrom is based on the concept that individual actions occur due to three main factors: The tools, the community, and the labour distribution in that community, as represented in **Figure 1**.

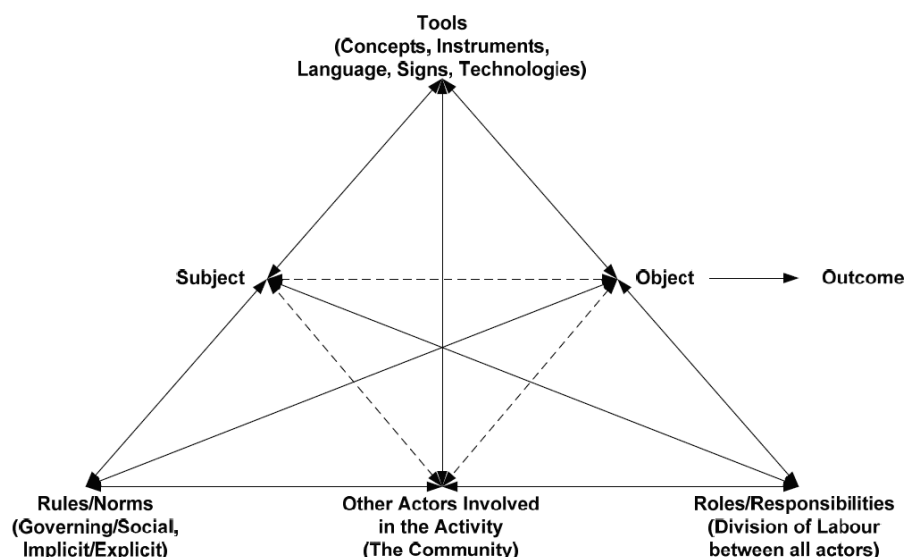


Figure 1. Engestrom's complex model of activity system [1].

Using Engestrom's complex model of the activity system as a theoretical lens to guide this study [1], the contextual factors represented by the extremities of the outer triangle and the elements of the internal triangle are identified for this study as per **Table 1** below:

Table 1. Engestrom's and this study activity system factors.

Engestrom's activity system factors	This study activity system factors
Role/ Responsibilities (division of labour between actors)	Faculty and students share the division of labour in the FC teaching pedagogy: Faculty prepare the videos for FC stage one, and students use them to learn. Faculty prepare the student-centered learning activities for FC stage two and use them in class with students to teach.
Rules/norms (Governing/Social Implicit /Explicit)	This is represented by the control of learning based on the activity theory framework suggested by the quantitative study of [48]. The control of learning includes using only student-centered, problem-solving activities.
Tools (Concepts, Instruments, Languages, Signs, Technologies)	This is represented by the FC technological tools: Interactive learning videos for FC stage one and electronic voting systems for FC stage two.
Subject	The learners
Object	The effectiveness of FC teaching pedagogy in improving students' learning outcomes
The Community (Other actors involved)	Public institution (the HEI where this activity is taking place)

Based on the above-listed activity system factors for this study, the activity system framework is summarised in **Figure 2** below.

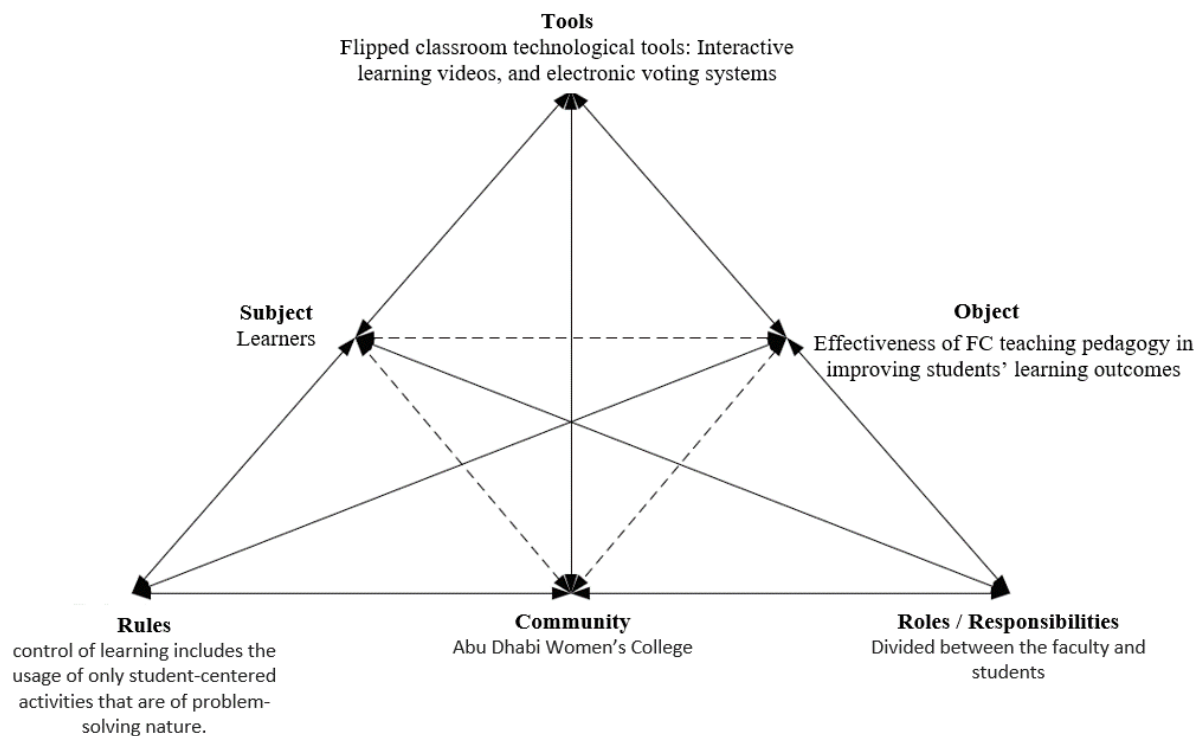


Figure 2. The activity theory framework for this study.

2.1. Research hypotheses

Based on the activity theory framework for investigating the mediating role of FC pedagogy on student learning outcomes as presented in the research design (**Figure 4 & Figure 5**), the following four hypotheses are put forward for testing:

H1: The average course grade for section 2 students in the CLO3 formative exam is significantly greater than that for section 1 students in CLO3.

H2: The average course grade for section 2 students in the CLO3 formative exam is significantly greater than their average course grade in CLO2

H3: There is a significant difference in the average course grade for section 1 students in CLO3 with their average course grade in CLO2.

H4: There is a significant difference in the average EmSAT scores between students in section 1 and section 2.

H1, H2, and H3 are derived from the activity theory framework (Figure 2), and proving them will establish the mediating role of the FC tools in improving students' learning outcomes as the object. In addition, proving these three hypotheses will also establish the mediating role of rules using student-centered activities on this object. Proving H4 will establish the community's mediating role, the ADWC, on the object where the EmSAT occurred. The four hypotheses are represented in Figure 3 below.

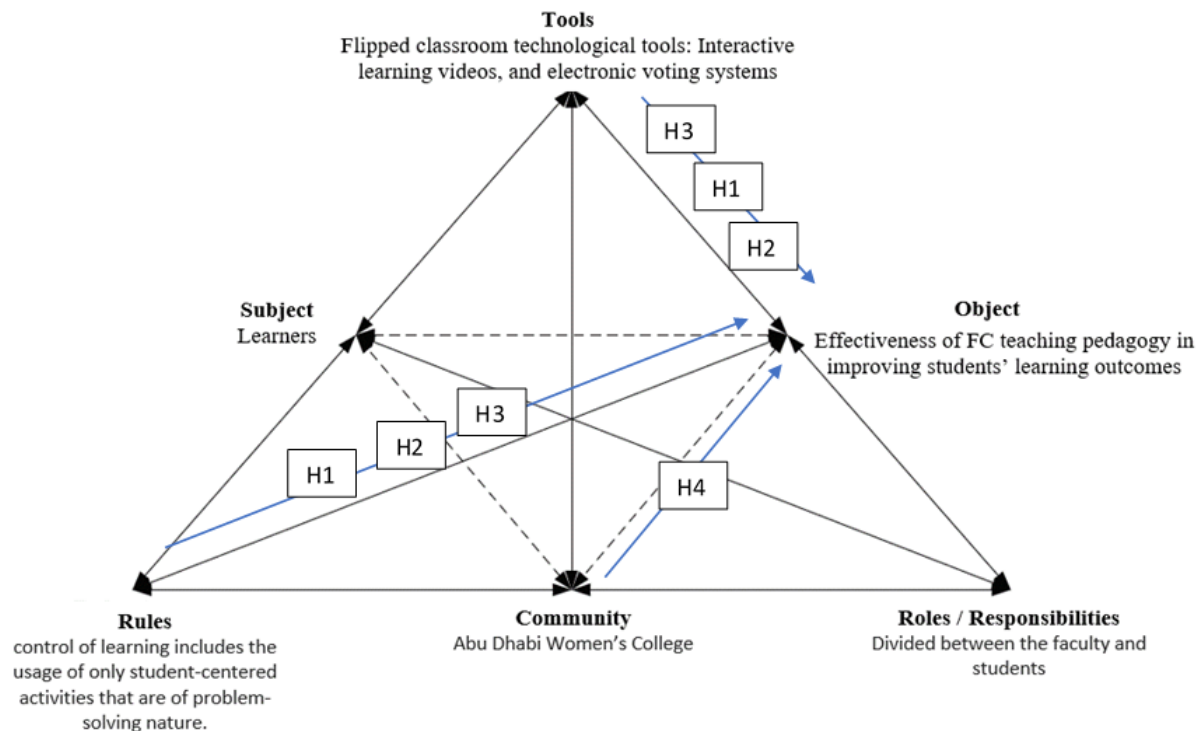


Figure 3. Research hypotheses.

3. Research Methodology

This research uses a statistical approach to understand how FC methods affect student results in university teaching. This study follows activity theory using a quasi-experimental design to examine how FC teaching connects with student success. A research team in the CIS department of a Middle Eastern higher education school taught two sections of the Human-Computer Interaction course with distinct teaching methods. One part of the study relied on standard teaching methods, whereas the other used FC approaches. This research compares student results to show how flipped learning affects learning outcomes and fills knowledge gaps about its impact in this learning environment.

3.1. Research design

A quasi-experimental design is selected for this research since the hypothesized cause of differences that this study aims to investigate has already occurred. Three main research designs are usually suggested for use in quantitative experimental research: the pre-experimental design, the true experimental design, and the quasi-experimental design [49]. A quasi-experimental research design investigates FC's impact on student learning outcomes.

Research was performed in Human-Computer Interaction (HCI) in two sections (section 1 and section 2) for third-year college students taking their courses. Twenty students are enrolled in each section. To minimize potential selection bias, students were allocated into the two sections based on standard administrative registration procedures without prior knowledge of the instructional methodology (traditional vs. flipped classroom). Both sections comprised students with comparable academic standing, as evidenced by similar average EmSAT scores. This procedure helped ensure comparability between groups, enhancing the internal validity of the study.

During the first five weeks of this semester, the first two-course learning outcomes, CLO1 and CLO2, were covered for sections 1 and 2 using traditional classroom teaching pedagogy. Over the next 5 weeks, section 1 was taught the CLO3 using the same traditional teaching pedagogy used for the first two CLOs, while section 2 was taught using the FC teaching pedagogy. Two formative assessments were conducted for both sections: one at the end of CLO1 and 2 and one at the end of CLO3. The two formative assessments were of the same type with multiple choice questions and an applied part and were delivered using the same learning management system: Blackboard Learn. Students' grades were collected at the end of the two assessments for both sections. **Figure 4** and **Figure 5** give a visual representation of the research site.

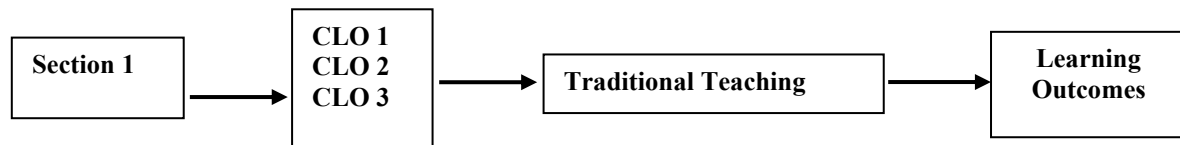


Figure 4. Section 1 traditional teaching model.

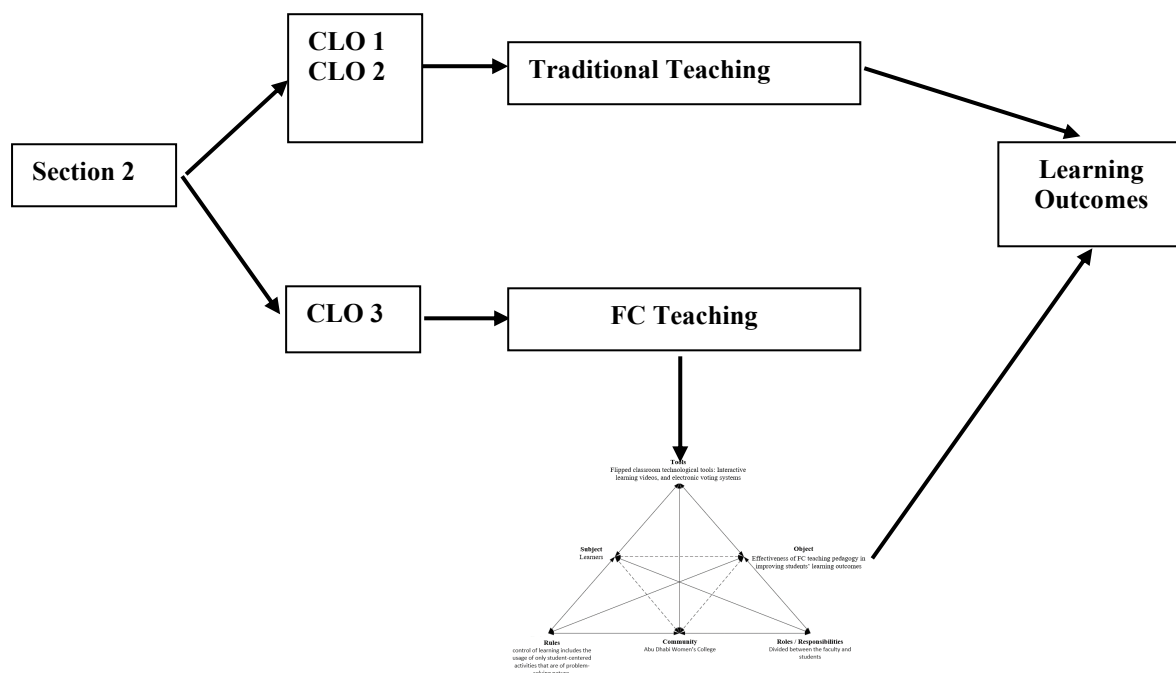


Figure 5. Section 2 FC teaching model.

An exogenous variable was used in the quasi-experimental design to increase the internal validity of this study. The entrance exam is a standardized test that all grade 12 students should take before joining any HEIs in the Middle East. The EmSAT scores are used in the admission decisions of the students at my college. HEIs consider EmSAT scores in the Middle East reliable and valid predictors of students' achievement and grades. There is no predicted percentage yet for the EmSAT with students' grades in HEIs, as this standardized test is still relatively new in the Middle East. However, HEIs in the Middle East have established their minimum acceptance criteria for admission. The EmSAT scores of the students in the two sections were collected.

3.2. Quality and trustworthiness of the study/findings

In order to improve the quality and trustworthiness of this study, several steps were implemented. First, the EmSAT exogenous variable was used in the quasi-experimental design. Second, four hypotheses were put forward for testing between a group-independent design (comparing results from section 2 with section 1) and a repeated measure design of a single group design (comparing results from section 2 itself). Finally, the quasi-experimental design validates causality empirically and permits researchers to study the causal effect of cognitive, motivational, and social variables [50-52].

Informed consent was obtained from all participants. The data collected in this research was used solely for the purposes of the study and was not shared with anyone. The personal information of the students was anonymized

and not identified. Digital data was stored securely and will be retained for three years before being deleted. This research fell under the exempt research type described by Cozby, as the risk of harm to participants was not greater than the risks they encountered during their regular activities [53].

4. Data analysis technique

The independent-means t-test compares grades between sections 1 and 2, and the dependent-means t-test compares the grades of the same students in the same section. The independent-means t-test is a statistical tool that compares and establishes differences between independent groups [54]. In this case, the grades of students in section 1 and section 2 are coming from two independent groups; hence, it is appropriate to use the independent-means t-test to look for differences. Therefore, the independent means t-test is used to analyze H1 and H4. On the other hand, the dependent-means t-test is a statistical tool used to investigate differences between means coming from the same entities in the same group [55]. In this case, the student's grades in the same section come from one group; hence, using the dependent-means t-test to look for differences is appropriate. Therefore, the dependent means t-test is used to analyze H2 and H3. The following descriptive statistical measures will also be used to compare means: Mean (M), Standard Deviation (Std), Standard Error Mean (SE), and Degree of Freedom (df). SPSS V25 is used to do all statistical calculations.

5. Findings

The four hypotheses are tested using sections 1 and 2, where students' grades were collected from the formative exams on CLO3 and CLO2 and students' EmSAT scores. The findings are then discussed.

5.1. Testing H1

In order to reject or accept H1, there is a need first to test its null hypothesis H0. The Null hypothesis H0 of H1 states no difference in the average CLO3 course grade between section 1 and section 2 (section 2 is taught using FC teaching pedagogy). Students' grades for the CLO3 formative exams for sections 1 and 2 were coded in SPSS. An independent-means t-test was conducted. Moreover, **Table 2** lists the descriptive statistical results and the t-test results:

Table 2. Evaluation of Results for Hypothesis 1.

Traditional Classroom/ Flipped Classroom?		N	Mean	Std. Deviation	Std. Error Mean				
Grades	Section 1 TC	20	74.25	7.348	1.643				
	Section 2 FC	20	81.25	8.104	1.812				
Independent Samples Test									
Grades	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	0.507	0.481	-2.862	38	0.007	-7.000	2.446	-11.952	-2.048
Equal variances are not assumed.			-2.862	37.641	0.007	-7.000	2.446	-11.995	-2.047

The calculation of the means reveals that section 2 students achieved higher average scores than section 1. Levene's test for equality of variances has the significance of $p = 0.48$, which means that the assumption of homogeneity of variance is met [55]. The confidence interval percentage is set at 95%, $t(38) = -2.86$ ($df = 38$), and the significance (2-tailed) is $p = 0.007$, which is less than 0.05; hence, H0 rejected, and H1 accepted. Based on these figures, it can be concluded that:

On average, course grades for students in section 2 ($M = 81.25$, $SE = 1.81$) were significantly greater than course grades achieved by students in section 1 ($M = 74.25$, $SE = 1.64$), $t(38) = -2.86$, $p = 0.007 < 0.05$. Therefore, H0 is rejected, and H1 is accepted. Accepting H1 establishes the significant impact of the mediating role of the tools and rules on the object in the activity theory framework listed in **Figure 2**.

5.2. Testing H2

The null hypothesis H0 of H2 states no difference between the grade averages achieved in CLO3 and CLO2 for students in section 2. Students' CLO3 and CLO2 formative exam grades were coded in SPSS. It is important to note that a traditional classroom teaching pedagogy was used to teach the CLO2 for section 2 students like other

students. Only the CLO3 was taught using the FC teaching pedagogy for section 2. A dependent t-test comparison was conducted on these grades since the study deals with repeated measured experiments with grades from the same group. **Table 3** lists the descriptive statistical results, the correlation results, and the t-test results.

Table 3. Evaluation of Results for Hypothesis 2.

Group Statistics								
		Mean	N	Std. Deviation		Std. Deviation Mean		
Pair 1	CLO2 Traditional Classroom	79.85	20	7.936		1.774		
	CLO3 Flipped Classroom	81.25	20	8.104		1.812		
Paired Samples Correlations								
Pair 1	CLO2 Traditional Classroom & CLO3 Flipped Classroom	N		Correlation		Sig.		
		20		0.962		0.000		
Paired Sample Test (Paired differences)								
Pair 1	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
CLO2 Traditional Classroom- CLO3 Flipped Classroom	-1.400	2.210	0.494	-2.434	-0.366	-2.833	19	0.011

The calculation of the means reveals that section 2 students achieved higher average scores in CLO 3 ($M = 81.25$) than in CLO2 ($M = 79.85$). Pearson's correlation coefficient $r = 0.96$ is a high correlation and significant since $p = 0 < 0.05$. The confidence interval percentage is set at 95%, $t(19) = -2.833$ ($df = 19$), and the significance (2-tailed) is $p = 0.011$, which is less than 0.05. Hence, H_0 is rejected, and H_2 is accepted. Based on these results, it can be concluded:

On average, CLO3 course grades for students in section 2 ($M = 81.25$, $SE = 1.81$) were significantly greater than course grades achieved by the same students in CLO2 ($M = 79.85$, $SE = 1.774$), $t(19) = -2.833$, $p = 0.011 < 0.05$. Therefore, H_0 is rejected, and H_2 is accepted. Accepting H_2 establishes the significant impact of the mediating role of the tools and rules on the object in the activity theory framework listed in **Figure 2**.

5.3. Testing H3

The null hypothesis H_0 of H_3 states no difference between the grade averages achieved in CLO3 and CLO2 for students in section 1. Students' CLO3 and CLO2 formative exam grades were coded in SPSS. It is important to note that a traditional classroom teaching pedagogy was used to teach CLO2 and CLO3. A dependent t-test comparison was conducted on these grades since the research deals with repeated measured experiments with grades from the same group. **Table 4** lists the descriptive statistical results, the correlation results, and the t-test results.

Table 4. Evaluation of Results for Hypothesis 3.

Group Statistics					
		Mean	N	Std. Deviation	Std. Deviation Mean
Pair 1	CLO2 Traditional Classroom	73.85	20	7.471	1.671
	CLO3 Flipped Classroom	74.25	20	7.348	1.643
Paired Samples Correlations					

Pair 1	CLO2 Traditional Classroom & CLO3 Flipped Classroom	N		Correlation		Sig.			
		20		0.976		0.000			
Paired Sample Test (Paired differences)									
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	CLO2 Traditional Classroom- CLO3 Flipped Classroom	-0.400	1.635	0.366	-1.165	-0.365	-1.094	19	0.288

The calculation of the means reveals that section 2 students achieved slightly higher average scores in CLO 3 ($M = 74.25$) than in CLO2 ($M = 73.85$). Pearson's correlation coefficient $r = 0.97$ is a high correlation and significant since $p = 0 < 0.05$. The confidence interval percentage is set at 95%, $t(19) = -1.094$ ($df = 19$), and the significance (2-tailed) is $p = 0.288$, which is more significant than 0.05. Hence, H_0 is accepted, and H_3 is rejected. Based on these figures, the following can be concluded:

On average, CLO3 course grades for students in section 1 ($M = 74.25$, $SE = 1.671$) were slightly more significant than course grades achieved by the same students in CLO2 ($M = 73.85$, $SE = 1.643$). However with $t(19) = -1.094$, $p = 0.288 > 0.05$, there is no significant difference that can be established. Therefore, H_0 is accepted, and H_3 is rejected. Rejecting H_3 establishes the significant impact of the mediating role of the tools and rules on the object in the activity theory framework listed in **Figure 2**.

5.4. Testing H4

The null hypothesis H_0 of H_4 states no difference between the EmSAT scores in sections 1 and 2. EmSAT scores for students in sections 1 and 2 were coded in SPSS. An independent-means t-test was conducted since the study deals with non-repeated measures. **Table 5** lists the descriptive statistical results and lists the t-test results.

Table 5. Evaluation of Results for Hypothesis 4.

Group Statistics										
Traditional Classroom/ Flipped Classroom?			N		Mean		Std. Deviation		Std. Error Mean	
Grades	Section 1		20		1157.45		31.882		7.129	
	Section 2		20		1155.70		28.310		6.330	
Independent Samples Test										
Grades		F	Sig.	t	df	Sig. (2- tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed		0.487	0.490	0.184	38	0.855	1.750	9.534	-17.5 51	-21.0 51
Equal variances are not assumed.				0.184	37.476	0.855	1.750	9.534	-17.5 60	-21.0 60

The calculation of the means reveals that students in section 1 have achieved slightly higher EmSAT average scores than those in section 2. Levene's test for equality of variances has the significance of $p = 0.49$, which means that the assumption of homogeneity of variance is met. The confidence interval percentage is set at 95%, $t(38) = 0.184$ ($df = 38$), and the significance (2-tailed) is $p = 0.855$, which is far greater than 0.05. Hence, H_0 cannot be rejected, and H_4 cannot be accepted. Based on these figures, it can be deduced:

On average, the EmSAT average score for students in section 1 ($M = 1157.45$, $SE = 7.129$) was slightly higher than the EmSAT average score for students in section 2 ($M = 1155.70$, $SE = 6.330$). However, this slight difference is insignificant since $t(38) = 0.184$, $p = 0.855 > 0.05$. Therefore, H_0 cannot be rejected, and hence H_4 is rejected. Rejecting H_4 establishes the significant impact of the mediating role of the community on the object in the activity theory framework listed in **Figure 2**.

6. Discussion

Research results demonstrate that FC methods help students achieve better results in Middle Eastern higher education settings. This study reveals that the new teaching method shows clear benefits in helping students perform better at school while staying more engaged mentally and achieving better results. Research shows that FC produces better student learning results than standard teaching practices [11]. Students in the FC section showed better results than their traditional peers because the flipped method creates an active learning space. The data shows that students in the FC approach learned better at CLO2 and CLO3 than those who received traditional teaching. The data supports Bradford *et al.*'s research, which found that students who learn with flipped instruction methods achieve higher test scores than students in traditional classrooms [38]. Traditional classroom teaching methods, such as the FC approach, fail to boost performance because they do not reach their full potential.

According to this research study, mediating factors in FC education play a central role. Through interactive videos and electronic voting systems, students became more engaged in problem-solving and group talks, and these tools helped them improve their studies. Ertmer and Ottenbreit-Leftwich's 2013 research confirms that technology-driven learning spaces create powerful change in education [22]. The research team used activity theory as a foundation to explore how FC teaching methods affect student learning results. The framework showed that tools, rules, and community relationships affect how well flipped pedagogy works. This research uncovers how FC enhances learning results by showing their important tools and elements.

By validating FC, this research highlights their usefulness for achieving HCT's strategic objectives. Institutional, educational goals and accreditation requirements become attainable through teaching strategies emphasizing student involvement. The research results show that FC transforms education beyond being an alternative to traditional instruction. Students gain essential critical thinking abilities and learn to solve problems with their peers through this method, according to Sergis *et al.* [7].

FC benefits in higher education must match the unique requirements of Middle Eastern educational environments. Traditional educational systems that put teachers in charge of student learning can block the change to student-focused methods.

Students who use traditional learning methods will find it hard when they need to take charge of their learning in FC. Teachers resist flipped teaching because they do not know digital tools for instruction and find developing interactive content too hard. According to Gouia-Zarrad and Gunn's findings in 2017, strong institutional backing is essential for flipped pedagogy success [41].

Higher education institutions must fund coaching for instructors to master FC skills and get needed materials. Faculty training workshops and technology access help teachers easily shift to FC teaching. Schools must guarantee equal student access to essential technology tools for flipped learning to work effectively, according to Schlairet *et al.* [44]. The success of FC methods depends on how well they match the learning material and what students need to achieve. The research focused on CIS department learning, but flipped teaching approaches work differently across subject areas. Courses built on practical application benefit most from flipped teaching, while theoretical lessons require different instructional methods. Each academic discipline needs its own customized FC strategy to work correctly.

This research shows that FC supports higher education objectives by creating a genuine student participation system. Institutions focus on preparing students for the modern workplace by making the FC approach essential. Higher education institutions use these methods to increase market value while preparing students to handle modern workplace requirements. This research confirms that FC teaching positively changes students' learning results. The inverted classroom model, combined with technology and active learning, creates a better teaching method than traditional methods at Middle Eastern universities. The research outcomes show why flipped learning should be used broadly despite facing implementation barriers. Schools that adopt this approach learn better students who become more engaged learners.

7. Study's limitation and future recommendation

This study has several limitations that provide avenues for future research. The scope of the research was confined to a single institution and focused on a specific course with a limited sample size. These constraints limit the generalizability of the findings to other contexts and disciplines. Additionally, this study did not examine the influence of demographic factors, such as gender or prior exposure to technology, which could play a role in determining the success of flipped pedagogy. Future research should explore these dimensions and consider longitudinal studies to assess the long-term impacts of FC on student outcomes. Furthermore, investigating how different technological tools interact with specific subject areas could provide insights into optimizing flipped pedagogical strategies.

8. Conclusion

This Research shows that FC learning methods generate substantial positive academic results at higher education institutions throughout the Middle East region. This was achieved by revealing the impact of the FC teaching pedagogy on students' performance among the students in the CIS department. Not only was the impact revealed, but a significant extent was confirmed. Using Engeström's complex model of the activity system, this study adopted an activity theory framework for FC teaching pedagogy, which was used as a lens to guide this quantitative study, which can also be used by other researchers interested in investigating FC teaching pedagogy's impact. This quantitative quasi-experimental study contributes to the body of knowledge on the impact of FC teaching pedagogy on students' cognitive learning outcomes in HEIs in the Middle East. This represents one step in addressing the lack of quantitative experimental studies identified in the literature review. However, many questions remain regarding the relationship between technology and FC and the impact of other variables, such as the demographic characteristics of students and faculty, course level, and subject matter. Further research is needed to extend the findings of this study to other departments in my college and other Middle East tertiary institutions.

Statement and declarations

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9. Appendix A: Video Recording Tools Used in the Flipped Classroom Model

1. Jing (TechSmith) – A free screen-capturing and recording tool (now retired). Website (archived): <https://www.techsmith.com/jing-tool.html>
2. Rendersoft CamStudio – An open-source desktop screen recorder. Website: <http://www.rendersoftware.com/>
3. Screen-O-Matic (Screencast-O-Matic) – A freemium tool for recording and editing screen content. Website: <https://screencast-o-matic.com>