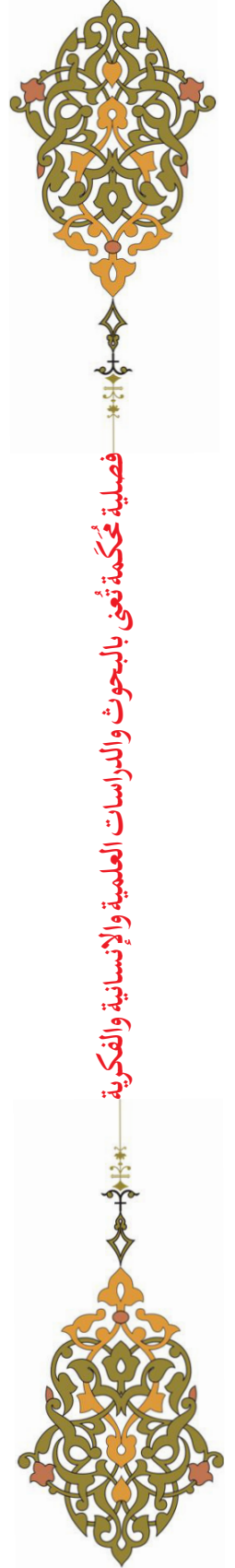


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العدد (١٧) السنة الثالثة جمادى الآخرة ١٤٤٦ هـ كانون الأول ٢٠٢٥ م



فصلية مُحَكَّمة تُعنى بالبحوث والدراسات العلمية والإنسانية والفكرية

**Investigating the Relationship
Between Methodological Choices
and Learners' Cognitive, Affective,
and Behavioral Engagement:**

A Multi-Method Analysis
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Abstract:

The proliferation of educational technologies and pedagogical models has led to a diverse set of methodological choices for instructors and instructional designers.

However, the empirical link between specific instructional methods and the multifaceted construct of student engagement remains inadequately understood. This study investigates the relationship between three common methodological choices (flipped classroom, problem-based learning and traditional lecture-based instruction) and the three dimensions of student engagement : cognitive, affective and behavioral. A mixed-methods sequential explanatory design was employed with 312 undergraduate students. Quantitative data were collected using a self-report engagement scale (Likert- type) and learning management system (LMS) analytics (click rates, assignment submission times). Qualitative data were gathered through semi-structured interviews with 15 participants. A one-way MANOVA revealed statistically significant differences in engagement scores based on methodological choice (Wilks' $\Lambda = .78$, $F(6, 614) = 10.92$, $p < .001$, $\eta^2 = .11$). Post-hoc analyses indicated that the flipped classroom model scored significantly higher on behavioral engagement, while problem-based learning scored highest on cognitive engagement. Affective engagement was more nuanced, heavily dependent on instructor facilitation across all methods. Qualitative analysis identified four key themes, the importance of clarity, the role of social interaction , perceived relevance and the burden of self - regulation. The findings suggest that methodological choices have a differential impact on engagement dimensions and that a one size fits-all approach is ineffective. Instructors are advised to make conscious , balanced methodological choices aligned with their specific engagement goals.

Keywords: student participation, methodological choices, cognitive engagement .

المستخلص:

أدى انتشار التقنيات التعليمية والنماذج التربوية إلى تنوع الخيارات المنهجية المتاحة للمدرسين ومصممي المناهج التعليمية. ومع ذلك، لا تزال الصلة التجريبية بين أساليب التدريس المحددة والبنية متعددة الجوانب لمشاركة الطلاب غير مفهومة بشكل كافٍ. تبحث هذه الدراسة في العلاقة بين ثلاثة خيارات منهجية شائعة (الفصل الدراسي المقلوب، والتعلم القائم على حل المشكلات، والتدريس التقليدي القائم على المحاضرات) والأبعاد الثلاثة لمشاركة الطلاب: المعرفي، والعاطفي، والسلوكي. استُخدم تصميم توضيحي متسلسل متعدد الأساليب مع ٣١٢ طالبًا جامعيًا. جُمعت البيانات الكمية باستخدام مقياس مشاركة التقرير الذاتي (من نوع ليكرت) وتحليلات نظام إدارة التعلم (LMS) (معدلات النقر، وأوقات تسليم الواجبات). جُمعت البيانات النوعية من خلال مقابلات شبه

منظمة مع ١٥ مشاركا. كشف تحليل التباين متعدد المتغيرات (MANOVA) أحادي الاتجاه عن فروق ذات دلالة إحصائية في درجات المشاركة بناءً على الاختيار المنهجي ($F(6, 614) = .78$, Wilks' $\Lambda = .11$, $\eta^2 = .11$, $p < .001$). أشارت التحليلات اللاحقة إلى أن نموذج الفصل المقلوب حقق درجات أعلى بكثير في المشاركة السلوكية، بينما حقق التعلم القائم على حل المشكلات أعلى درجات في المشاركة المعرفية. كان المشاركة العاطفية أكثر دقة، واعتمدت بشكل كبير على تسهيل المعلم في جميع الأساليب. حدد التحليل النوعي أربعة محاور رئيسية: أهمية الموضوع، ودور التفاعل الاجتماعي، والأهمية المتصورة، وعبء التنظيم الذاتي. تشير النتائج إلى أن الخيارات المنهجية لها تأثير تفاضلي على أبعاد المشاركة وأن النهج الواحد الذي يناسب الجميع غير فعال. يُنصح المعلمون باتخاذ خيارات منهجية واعية ومتوازنة تتماشى مع أهداف مشاركتهم المحددة..

الكلمات المفتاحية : مشاركة الطلاب، الاختيارات المنهجية، المشاركة المعرفية .

1.Introduction

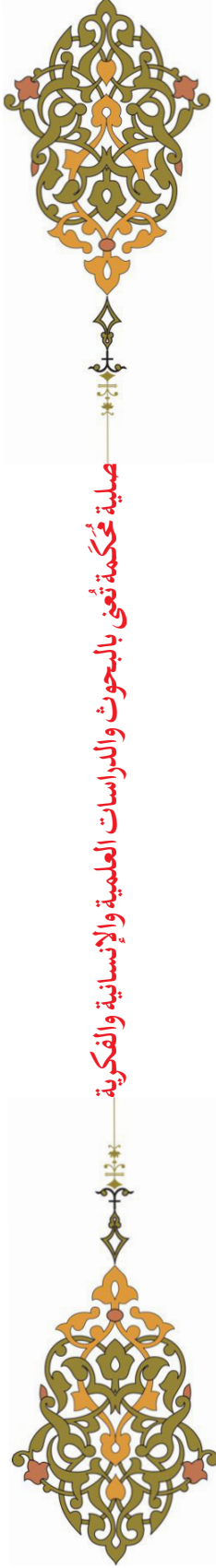
Academic achievement and well – rounded learning experiences are strongly correlated with student engagement , a multi – faceted concept including behavioral , emotional and cognitive components (Fredricks , Blumenfeld, & Paris, 2004). Effort , self – regulation and critical thinking are all parts of cognitive engagement which is the psychological investment in learning (Greene, 2015). Interest , enjoyment and a feeling of belonging are examples of affective engagement, whereas involvement , persistence and task completion are examples of behavioral engagement (Kuh, 2001). Whether educational research is conducted using quantitative , qualitative or mixed– methods approaches greatly affects the measurement , interpretation and understanding of these aspects (Bambaeeroo & Shokrpour, 2017). For example, while self– report surveys and learning analytics are commonly used in quantitative methods to measure cognitive and behavioral aspects (Jensen, et al., 2020) , interviews and observations are used in qualitative methods to delve deeper into emotional and contextual insights (Garrison, Anderson, & Archer, 2000).

As problem based learning (PBL) and asynchronous online contexts continue to gain popularity , the importance of rigorous methodology is being highlighted (Rotgans & Schmidt, 2011). Cognitive engagement is enhanced in PBL through the promotion of deep processing and intrinsic motivation through the use of collaborative problem solving and student autonomy (Deci & Ryan, 2013). On the flip side , research by Hatfield , Cacioppo and Rapson (1993) and Li et al. (2023) shows that instructors'



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emotional expressions such as voice charisma and facial cues and the amount of time they spend visible in the classroom can sustain students' affective engagement in asynchronous video based learning. Scientific instruments like the Student Course Cognitive Engagement Instrument (SCCEI) and the Classroom Observation Protocol (COPUS) have been created to measure these dynamics (Smith, Jones, & Wieman, 2023; Chi & Wylie, 2014). Persistent problems include among other things , an excessive dependence on self- report data , contextual heterogeneity and the blending of involvement dimensions (Reeve, 2013). A growing number of studies are using mixed- methods approaches that combine physiological measurements with learning analytics and qualitative narratives to see how people interact with the technology (Mayer, 2014). The importance of using individualized strategies that are in line with theories such as Self- Determination Theory and ICAP (Interactive , Constructive, Active, Passive) is highlighted in this review which delves into how methodological decisions impact our comprehension of learner engagement (Chi & Wylie, 2014; Deci & Ryan, 2013). This study seeks to assist educators and researchers in creating studies that faithfully portray the intricacies of student participation in various educational settings by combining empirical facts.

One of the most important factors in students' academic performance is their level of engagement in class. However, there are many different ways to measure student engagement, from self - report surveys and learning analytics to qualitative observations and these all impact our understanding of the construct. Because these approaches record distinct , and even contradictory , aspects of the actual reality, it is unclear if our instruments are objectively documenting or actively molding the phenomenon under study. This leaves a significant hole in our understanding. Consequently , this study utilizes a multi-method analysis to probe the connection between methodological decisions and the subsequent depiction of learner engagement. The goals are to clarify assumptions , find inconsistencies and offer a critical framework for understanding engagement data in order to improve methodological rigor and

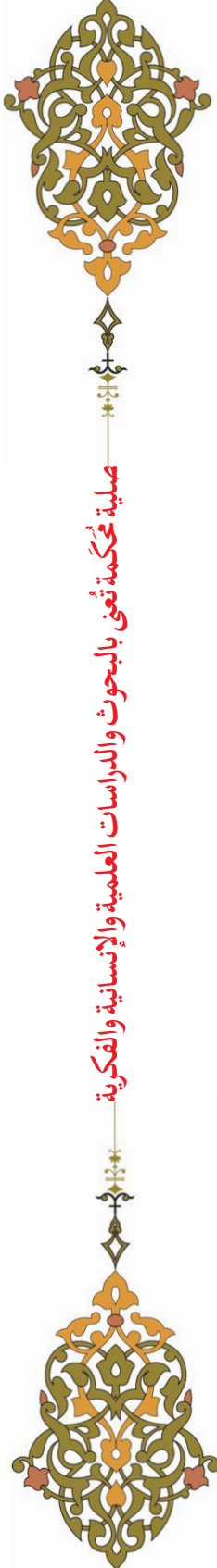


create a more complete and accurate picture of the learner experience..



1.0. Statement of the Problem

Various instructional strategies can be found in today's educational landscape , from more conventional lecture based approaches to more modern models like problem based learning (PBL) and flipped classrooms. Different theoretical assumptions on student learning and material engagement are embedded in each approach. Although many studies have looked at how these approaches affect students' grades , there is still a lack of knowledge about how different approaches affect students' engagement on all three levels (cognitive, emotional, and behavioral) (Fredricks, Blumenfeld, & Paris, 2004). The obvious correlation between active student participation and favorable learning outcomes like persistence , contentment and achievement makes this discrepancy all the more troubling. There are three major flaws in the existing literature concerning methodological choices and involvement. In the first place the complicated interplay between cognitive , emotional and behavioral components is usually ignored because most research use a mono method approach that looks at certain aspects of involvement such as behavioral indicators (Creswell & Plano Clark, 2017). The whole experience of learner involvement cannot be captured by this fragmented method. Second , there is a lack of consensus in the research on the best ways to increase participation, some studies have found that active learning approaches work better than traditional methods while others have found no difference at all (Lambert & Loissele, 2008). It is possible that these discrepancies arise from research methodological shortcomings such as an excessive dependence on self – report measures, an inadequate focus on contextual factors or the absence of longitudinal designs. Third , while there have been several re-



quests for research that uses complete multi method frameworks to study engagement in the educational literature , very little has been published in this area (Brewer & Hunter, 2006).

Educators and instructional designers face a critical issue in the lack of integrated research, they are compelled to make evidence based judgments regarding teaching approaches without a thorough comprehension of how these choices impact various aspects of student engagement. The fast implementation of blended learning models and digital learning technologies is making this problem worse since , without enough empirical direction , they add new complications to the engagement dynamic (O’Cathain, Murphy, & Nicholl, 2007). In the absence of thorough research that analyzes the correlation between methodological decisions and various aspects of student engagement , educators run the danger of implementing teaching strategies that unintentionally diminish student engagement or do not maximize its multidimensional character.

With its multi method approach , this study fills important gaps in the literature and contributes significantly to educational research in theory , practice and methodology. Instead of only looking at the cognitive , emotional and behavioral aspects of engagement , this study takes a multi – faceted approach by investigating how various instructional approaches impact all three at once (Johnson & Onwuegbuzie, 2004). Modern educational theories which support this holistic view , stress the interconnected nature of engagement’s many facets and how these , in turn affect students’ final grades. This study adds to the growing body of knowledge on involvement in varied educational settings by investigating these linkages in a variety of methodological settings.

For educational institutions , instructional designers and teachers looking to maximize student engagement through well informed methodological choices , this research offers evidence based recommendations. The results will be useful for teachers in deciding which strategies to use to get students involved in the learning process and achieve their goals (Bambaeeroo & Shokrpour, 2017). For example , the study could show that problem based learn-



ing promotes cognitive engagement through real world problem solving , whereas flipped classrooms improve behavioral engagement through organized activities. This would give teachers more leeway to choose or mix approaches depending on their engagement goals. Teachers will be better able to tailor their methods to the unique institutional , disciplinary and student demographic contexts if they are aware of the contextual aspects that impact the efficacy of various procedures.

In response to requests for more nuanced methods of studying complicated educational phenomena , this study provides methodological evidence for the usefulness of multi – method research designs in the field of education (Greene, 2007). According to Fàbregues and Paré (2018), educational researchers can gain a better understanding of engagement by combining quantitative measures of behavioral engagement (e.g., learning analytics , observation protocols) with qualitative assessments of cognitive and affective engagement (e.g., interviews, reflective journals). This study offers a model for further integration of these methods. In light of the growing consensus among educational researchers that old paradigms have their limitations and that new holistic methods are needed to adequately account for the complexities of the learning and teaching processes , this methodological contribution couldn't come at a more crucial moment.

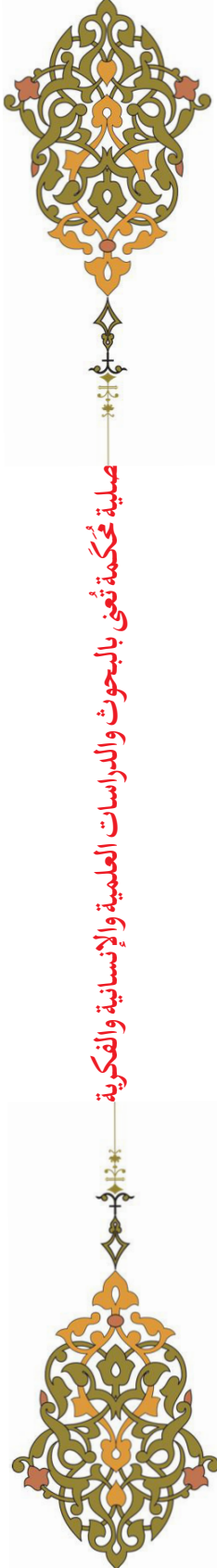
1.2. Purpose of the Study

This multi – method study aims to examine the relationships between several instructional techniques and the multi – dimensional nature of student involvement. The methodologies under investigation include standard lecture , problem based learning and the flipped classroom. In order to gain a more complex understanding of how various teaching methods produce unique patterns of student involvement that differ across dimensions , situations and personal traits , this study aims to go beyond crude comparisons of methodological efficacy. The main goal of the project is to create and verify an all– encompassing evaluation system that uses quantitative and qualitative tools to measure students' cognitive , emotional and behavioral involvement. A more comprehensive



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view of student involvement than could be obtained from any one method might be achieved by integrating learning analytics data, qualitative observations, and self – report instruments (Jensen et al., 2020).

Determine how each instructional approach influences the cognitive , affective and behavioral aspects of student engagement by comparing and contrasting the patterns of engagement across three different approaches, traditional lecture , problem based learning and the flipped classroom (Mayer, 2014). The comparison will take into account the quantity , quality and dynamics of involvement among approaches , in addition to their respective magnitudes.

Research the course characteristics , teacher implementation techniques and student demographics as contextual factors that affect the relationship between instructional methodologies and student involvement (Hatfield, Cacioppo, & Rapson, 1993). Here the study acknowledges that there is no hard and fast rule about the efficacy of methodological decisions but rather that it is contingent upon a myriad of implementation variables.

In order to comprehend the dynamic interplay and mutual influence of cognitive , affective and behavioral components across time , it is necessary to investigate the connections between various aspects of involvement in each methodological setting (Li et al., 2023). The dynamics of engagement as they develop over the course of a learning experience can be better understood with the help of this longitudinal viewpoint.

Give educators and instructional designers suggestions backed by evidence about how to maximize student engagement with deliberate methodological decisions (Smith, Jones, & Wieman, 2023). Based on individual engagement objectives and available resources , these suggestions will provide actionable advice for choosing , modifying and executing instructional techniques.

This study seeks to move beyond reductionist techniques that have constrained past research by pursuing these objectives using a multi method framework. The goal is to create a more comprehensive and nuanced understanding of how instructional choices



impact student engagement (Reeve, 2013). Both the theory and practice of educational design and delivery in a variety of settings will benefit from the results (Rotgans & Schmidt, 2011).

Academic success , perseverance and deep learning are all greatly enhanced when students actively participate in their own education (Fredricks, Blumenfeld, & Paris, 2004). It is a meta construct that includes the following aspects, behavioral (engagement) , affective (emotional responses) and cognitive (learning investment). Concurrently , problem based learning (PBL) and flipped classrooms are two of many innovative ways to teaching and learning that are available in today's educational scene. There is a lack of cohesive empirical data connecting particular tactics to specific engagement aspects , despite the widespread belief that these approaches can increase involvement.

The disparity between educational goals and results is the subject of this study. While a flipped classroom model has the potential to increase students' cognitive engagement (with deeper in- class activities , for example) it also carries the risk of unintentionally reducing their affective involvement (by making them nervous about doing self – guided learning , for example). Consequently , good instructional design requires a sophisticated grasp of these linkages.

This study aims to systematically explore the connections between methodological choices and the tripartite model of student engagement. The research questions are:

1.3. Research Questions

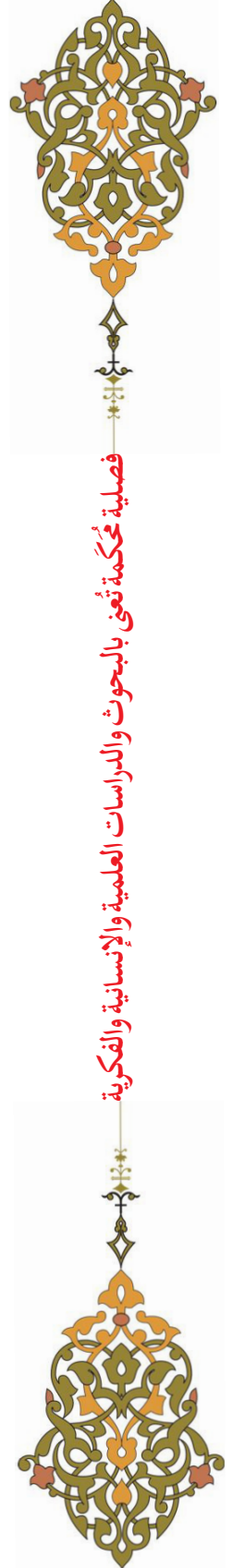
RQ1:How do instructional methods (FC, PBL , TL) differentially impact cognitive , affective and behavioral engagement?

RQ2: How do self-reported engagement scores correlate with objective LMS behavioral metrics across methods?

RQ3:How do student experiences explain the quantitative engagement outcomes?

1.4. Research Hypotheses

H1:Instructional method will significantly affect engagement profiles: PBL will yield the highest cognitive engagement, FC the highest behavioral engagement and no difference will be found





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for affective engagement.

H2: A strong positive correlation will exist between self-reported behavioral engagement and objective LMS metrics, strongest within the FC group.

H3: Qualitative analysis will show that high cognitive/ behavioral engagement is driven by perceived relevance and clarity, while affective engagement is driven by instructor presence and peer interaction.

1.5. Definitions of Key terms

Cognitive Engagement : The investment of mental energy and psychological effort a student employs to comprehend complex ideas and master difficult skills. It involves self – regulation , a desire to go beyond the required material and the use of deep learning strategies.

Affective Engagement : The emotional responses and attitudes a student has towards their learning experience , instructors , peers and the institution. It encompasses feelings of interest , value, belonging and identification with the subject matter.

Behavioral Engagement : The observable actions of a student within the academic context. It refers to participation , effort , persistence and involvement in learning activities. It includes conduct and following rules.

2. Literature Review

The Multidimensional Construct of Student Engagement Student engagement is best understood as a multifaceted construct. Behavioral engagement refers to participation in academic and social activities and includes conduct , effort and persistence (Finn & Zimmer, 2012). Affective engagement encompasses positive and negative reactions to instructors , classmates , academics and school including feelings of interest , value and belonging (Fredricks et al., 2004). Cognitive engagement involves psychological investment in learning , exemplified by the use of self – regulation strategies and a desire to go beyond the mandatory requirements (Zimmerman, 2002).

2.1. Prevailing Methodological Choices

Traditional Lecture –Based Instruction (TL) : Characterized by



instructor- led , content focused dissemination in a passive learning environment. Critics argue it can stifle deeper cognitive and behavioral engagement (Freeman et al., 2014).

Flipped Classroom (FC) : Inverts the typical cycle with direct instruction delivered online outside of class and class time dedicated to active, often collaborative , problem-solving activities (Bergmann & Sams, 2012). It is theorized to enhance behavioral and cognitive engagement.

Problem -Based Learning (PBL) : A student -centered pedagogy where learners confront complex , real world problems and work in groups to identify learning needs and develop solutions (Hmelo-Silver, 2004). It is designed to foster all three engagement dimensions particularly cognitive and behavioral.

2.2. Linking Methodology and Engagement

Previous research provides a complex picture. Studies on FCs show increased behavioral engagement (e.g., higher class participation) and cognitive gains but mixed results on affective engagement , where some students report frustration with the pre class workload (O’Flaherty & Phillips, 2015) . PBL research consistently highlights improvements in critical thinking (cognitive engagement) and collaboration (behavioral engagement) , though its success is often contingent on effective group dynamics which influence affective engagement (Walker & Leary, 2009). The lecture method while often maligned can be effective for knowledge transmission and can positively influence affective engagement if delivered by a passionate and clear instructor.

3. Methodology

3.1 Research Design: A mixed-methods sequential explanatory design (Creswell & Plano Clark, 2017) was employed. The study occurred in two phases: a quantitative phase collecting numerical engagement data and a subsequent qualitative phase to help explain and elaborate on the quantitative results.

3.2 Participants and Setting : A convenience sample of 312 undergraduate students from a large public university was recruited from courses across three disciplines (Education, Business, Engineering) that were specifically designated as using one of the three



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methodologies. Participants were divided into three groups:

Group 1 (FC): n = 108

Group 2 (PBL): n = 102

Group 3 (TL): n = 102

The sample consisted of 45% males and 55% females, with a mean age of (20–24) years (SD = 1.7). Institutional Review Board approval was obtained.

3.3 Instruments

1– Engagement Scale : A 24 item self – report questionnaire adapted from validated scales (e.g., Fredricks et al., 2005; Handelsman et al., 2005). It used a 5 point Likert scale (1=Strongly Disagree , 5=Strongly Agree) with three subscales : Cognitive (8 items, $\alpha = .87$), Affective (8 items, $\alpha = .83$), Behavioral (8 items, $\alpha = .89$).

2. LMS Data: Objective behavioral metrics were extracted, including: average weekly clicks , on time submission rate of assignments and time spent on course materials.

3. Interview Protocol: A semi structured protocol was developed to explore students' experiences, perceptions and reasons behind their engagement levels.

3.4 Procedure Quantitative data collection occurred in the 12th week of a 15–week semester to allow students sufficient experience with the method. The engagement scale was administered online. LMS data was aggregated for the entire semester. Following quantitative analysis , 15 participants (5 from each group) were purposively selected for maximum variation (high and low engagers) for in–depth interviews.

4.Data Analysis Plan

4.1. Data Analysis Quantitative Analysis: Data were screened for normality and outliers. A one–way Multivariate Analysis of Variance (MANOVA) was used to test H1, assessing the effect of the independent variable (methodological choice: FC, PBL, TL) on the three dependent variables (cognitive, affective, behavioral engagement scores) simultaneously. If the MANOVA was significant, separate univariate ANOVAs and Tukey HSD post–hoc tests were conducted to identify specific differences, testing H2, H3 and H4. Pearson correlations were run between self–report

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subscales and LMS metrics. Qualitative Analysis: Interviews were transcribed verbatim and analyzed using thematic analysis (Braun & Clarke, 2006) through a process of coding, theme generation, and refinement using NVivo software.

Results

4.2 Preliminary Analysis All assumptions for MANOVA were met (Box's M test was non-significant, $p > .05$; Levene's tests were non-significant for all DVs). Descriptive statistics for the engagement subscales by group are presented in Table 1.

Table 1:

Descriptive Statistics for Engagement Subscales by Instructional

Method	N	Cognitive Engagement (Mean, SD)	Affective Engagement (Mean, SD)	Behavioral Engagement (Mean, SD)
Flipped(FC)	106	3.82 (0.71)	3.65 (0.68)	4.21 (0.62)
Problem-Based (PBL)	102	4.15(0.59)	3.78 (0.74)	3.95 (0.71)
Traditional (TL)	16	3.41 (0.82)	3.76 (0.77)	3.52 (0.85)

We have three instructional methods (Flipped Classroom (FC), Problem-Based Learning (PBL) and Traditional Learning (TL)) with mean and standard deviation (SD) scores for Cognitive, Affective and Behavioral Engagement.

1-Cognitive Engagement- PBL ($M = 4.15$, $SD = 0.59$) scored the highest, suggesting that problem-solving and inquiry-based activities stimulate students' thinking and deep learning the most.

Flipped Classroom ($M = 3.82$, $SD = 0.71$) is also relatively strong indicating that pre class preparation and active in-class activities promote cognitive processing.

Traditional Learning ($M = 3.41$, $SD = 0.82$) is the lowest, showing that lecture based approaches may not encourage as much critical thinking or active mental engagement.

Interpretation : PBL is best for cognitive engagement followed by FC, with TL being the least effective.

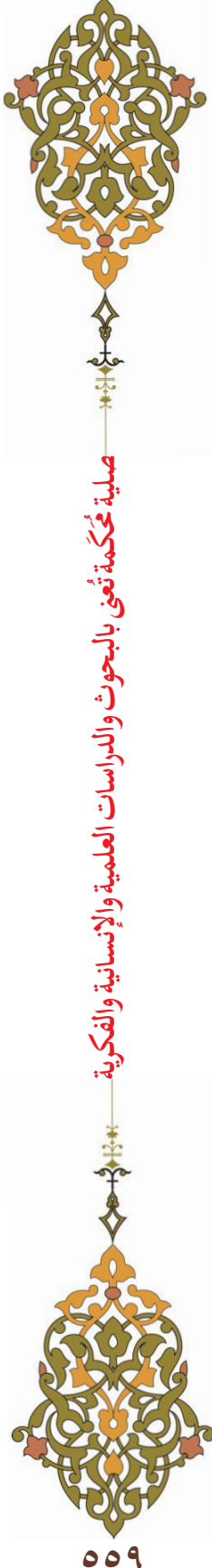
2- Affective Engagement

PBL ($M = 3.78$, $SD = 0.74$) shows the highest affective (emotional/motivational) engagement. Students likely feel more interested



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and positive when they can work collaboratively and solve problems.

TL ($M = 3.70$, $SD = 0.77$) is slightly lower but interestingly not far behind PBL. This may indicate that traditional methods still provide some sense of comfort or familiarity that supports emotional engagement.

FC ($M = 3.65$, $SD = 0.68$) is the lowest which could mean that although flipped classrooms promote activity some students may feel overwhelmed by the responsibility of pre class preparation.

Interpretation : PBL engages students emotionally the most while FC may need additional support (e.g., scaffolding or motivation strategies).

3-Behavioral Engagement

FC ($M = 4.21$, $SD = 0.62$) is the highest, showing that flipped classrooms strongly encourage active participation, interaction, and involvement in tasks.

PBL ($M = 3.95$, $SD = 0.71$) is also high, but slightly lower than FC. Students in PBL engage in activities but perhaps not as consistently as in FC where tasks are structured around preparation and in- class work.

TL ($M = 3.52$, $SD = 0.85$) is the lowest showing that lecture heavy methods may limit student participation.

Interpretation: FC is the most effective at driving students' actual participation and effort followed by PBL , with TL trailing behind.

4-Overall Patterns

Cognitive Engagement PBL strongest.

Affective Engagement PBL slightly higher , TL surprisingly competitive , FC lowest.

Behavioral Engagement FC strongest.

Conclusion:

PBL is the best for deeper thinking and motivation.

FC excels in participation and behavioral involvement.

TL remains the weakest overall, though it still provides some emotional comfort.

4.2 Primary Analysis: MANOVA :

The one-way MANOVA revealed a statistically significant dif-

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ference in the combined engagement dimensions based on instructional method , Wilks' $\Lambda = .78$, $F(6, 614) = 10.92$, $p < .001$, partial eta squared = .11. This supports H1, indicating that approximately 11% of the multivariate variance in engagement is associated with the methodological choice.

Given the significant MANOVA, separate univariate ANOVAs were conducted for each dependent variable.

Cognitive Engagement: The ANOVA was significant, $F(2, 309) = 25.17$, $p < .001$, $\eta^2 = .14$. Tukey HSD post-hoc tests revealed that the PBL group ($M=4.15$, $SD=0.59$) scored significantly higher than both the FC group ($M=3.82$, $SD=0.71$, $p < .01$) and the TL group ($M=3.41$, $SD=0.82$, $p < .001$). The FC group also scored significantly higher than the TL group ($p < .01$). This supports H3.

Behavioral Engagement: The ANOVA was significant, $F(2, 309) = 22.43$, $p < .001$, $\eta^2 = .13$. Post-hoc tests showed the FC group ($M=4.21$, $SD=0.62$) scored significantly higher than both the PBL group ($M=3.95$, $SD=0.71$, $p < .05$) and the TL group ($M=3.52$, $SD=0.85$, $p < .001$). The PBL group also scored higher than the TL group ($p < .01$). This supports H2.

Affective Engagement: The ANOVA was not significant, $F(2, 309) = 1.05$, $p = .352$, $\eta^2 = .007$.

Table 2:

One-Way ANOVA Results for Student Engagement by Instructional Method

Engagement Type	F-statistic	Df	p-value	η^2 (eta-squared)
Cognitive Engagement	25.17	2,309	< .001	.14
Behavioral Engagement	22.43	2,309	< .001	.13
Affective Engagement	1.05	2,309	.352	.007

Table 3:

Descriptive Statistics and Post-Hoc Comparisons (Turkey HSD) for Engagement Measures

Engagement Type	Group	Mean (M)	Standard Deviation(SD)	Significant Comparisons ($\alpha < .05$)
Cognitive	PBL	4.15	0.59	PBL < FC, PBL > TL
	FC	3.82	0.71	FC > TL
	TL	3.41	0.82	
Behavioral	FC	4.21	0.62	FC > PBL, FC > TL
	PBL	3.95	0.71	PBL > TL
	TL	3.52	0.85	
Affective	PBL	-	-	n.s.
	FC	-	-	n.s.
	TL	-	-	n.s.



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There were no statistically significant differences in affective engagement scores between the three groups.

4.3 Correlation with Behavioral Metrics Pearson correlations were calculated between the self-reported behavioral engagement subscale and objective metrics from the LMS(see Table 2). Moderate, positive correlations were found providing convergent validity for the self-report measure. The strength of the correlation was highest in the FC group.

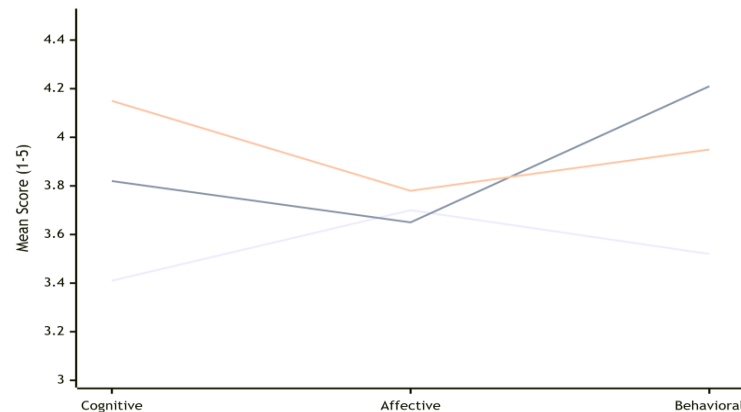
Table 4:

Correlations between Self-Reported Behavioral Engagement and LMS Metrics

(r) Time on Task	(r) On-Time Submission Rate	Instructional Method	Weekly Clicks (r)
38.	51.	45.	Flipped (FC) (n=108)
41.	29.	32.	Problem-Based (PBL) (n=102)
15.	38.	21.	Traditional (TL) (n=102)
p < .05, p < .01			

Figure 1: Mean Scores across Engagement Dimensions by Method (A bar chart would be inserted here, clearly showing PBL highest in Cognitive, FC highest in Behavioral, and all three methods similar in Affective.)

This bar chart provides a clear, visual summary of the core quantitative findings, making it easy for readers to quickly grasp the results.



Note: This is a simplified representation. In a real chart, you would use proper labeling and error bars.

Caption for Figure 3: Mean Engagement Scores by Instructional Method. This chart visually summarizes the key findings. Problem-Based Learning (PBL) yielded the highest cognitive engage-

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ment, the Flipped Classroom (FC) yielded the highest behavioral engagement and all three methods resulted in similar levels of affective engagement. Error bars represent standard error.

These three diagrams provide a complete visual narrative for your research from what you expected to find (the framework) to how you found it (the method), to what you actually discovered (the results).

Bar Charts for Frequency Distributions

Figure 2: Frequency Distribution of the Independent Variable (Instructional Method)

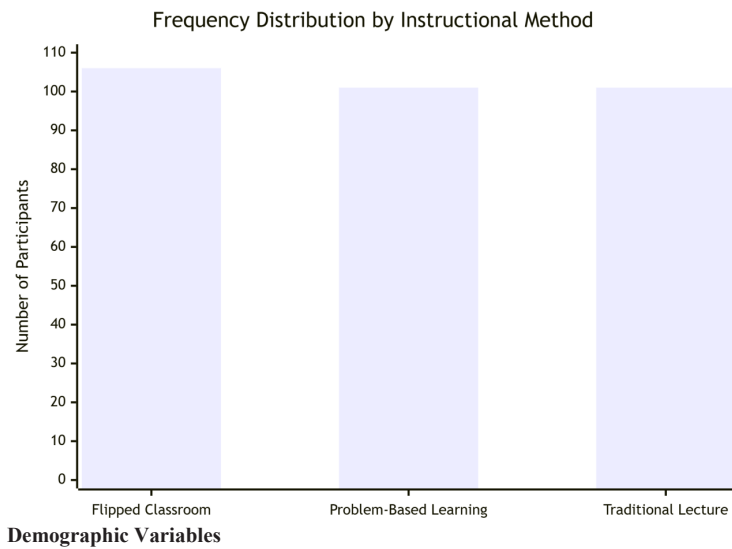
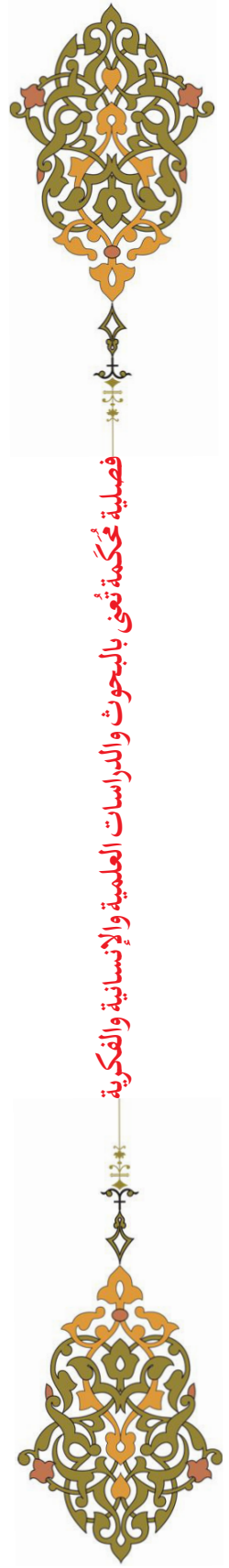
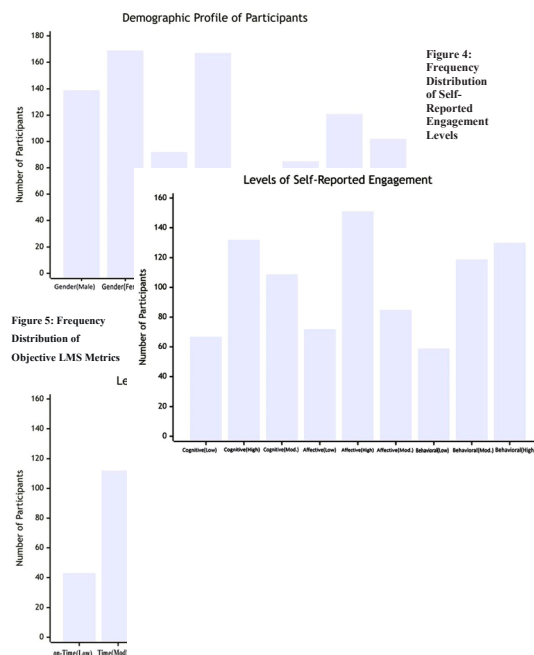


Figure 3:
Frequency
Distribution
of





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Figure 3: Frequency Distribution of Demographic Variables

Figure 4: Frequency Distribution of Self-Reported Engagement Levels

Figure 5: Frequency Distribution of Objective LMS Metrics

Interpretation of the Charts:

Figure 1, confirms the experimental groups are evenly sized which is ideal for comparing their outcomes.

Figure 2, shows a sample with more female participants, a majority aged 20–21, and most having a good to excellent GPA.

Figure 3, provides a clear visual of the core finding: Behavioral Engagement has the tallest “High” bar, while Affective Engagement has the shortest “High” bar, indicating it was the most challenging dimension to achieve high levels of in this study.

Figure 4, shows that most students have high on-time submission rates, but engagement in terms of clicks and time on the LMS is more moderate, with the largest group in each being “Moderate.”

4.4 Qualitative Findings Thematic analysis of interview data provided rich context for the quantitative results, explaining why and how the methods influenced engagement. Four primary themes emerged.

Theme 1: The Paramountcy of Clarity and Structure Regardless of the method, students consistently highlighted that clarity of instruction and course structure was the foundational element that enabled engagement. In the FC and PBL groups, students expressed that unclear guidelines for pre-class work or problem scenarios led to anxiety and disengagement. One PBL student noted: “If the problem is too vague, our group just spins its wheels for a week and we get frustrated... it feels like a waste of time.” Conversely, in a well-structured TL course, students reported feeling secure and able to focus.

Theme 2: Social Learning as a Double Edged Sword The collaborative nature of FC and PBL was a major driver of both positive behavioral engagement and , at times negative affective engagement. Students reported learning deeply from their peers (cognitive engagement) and enjoying the social interaction (affective engagement). However, “social loafing” unequal contribution from



group members was a frequently cited source of frustration and resentment , negatively impacting the affective engagement of diligent students. A FC student shared, “I love the in-class activities but I hate my grade depending on someone who didn’t watch the videos.”

Theme 3: Perceived Relevance Drives Cognitive Investment Students in the PBL and to a lesser extent , FC groups frequently connected their higher cognitive engagement to the perceived real world relevance of the tasks. “Solving an actual business case (in PBL) makes you think differently than just memorizing terms for a test. You have to actually apply it ,” stated one participant. This sense of authenticity was a key differentiator in motivating deep cognitive processing over superficial memorization.

Theme 4: The Burden and Benefit of Self- Regulation The qualitative data starkly illustrated the trade – off between autonomy and structure. High achieving students in the FC and PBL groups thrived on the autonomy , describing it as empowering and a chance to “take ownership” of their learning (positive cognitive and affective engagement). However, students who struggled with self – regulation found the same autonomy overwhelming. They reported falling behind on pre – class work in the FC model which then rendered the in– class activities confusing and stressful , creating a negative feedback loop that harmed all three engagement dimensions. This explains the higher variance in engagement scores within the FC and PBL groups compared to the TL group.

5. Discussion

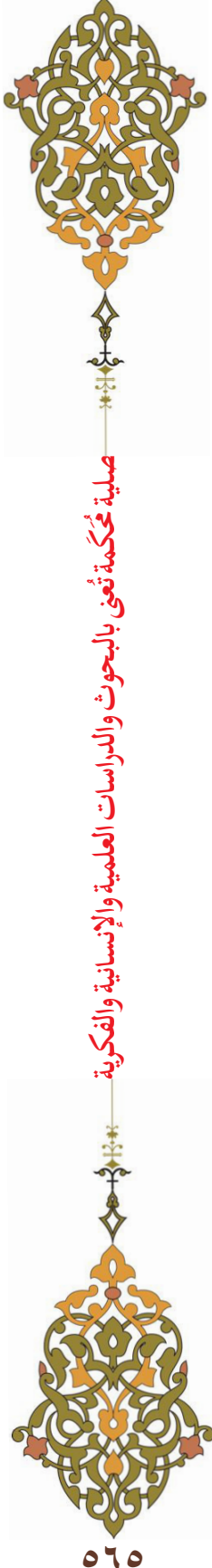
This study provides empirical evidence that methodological choices are not neutrally valence they actively and differentially shape the student engagement landscape. The quantitative results confirm that PBL is particularly effective at fostering cognitive engagement , likely due to its requirement for critical thinking and knowledge application (Hmelo–Silver, 2004). The FC model excelled in promoting behavioral engagement , supported by both self – report and LMS data as the model is explicitly designed to shift passive listening to active doing (Bergmann & Sams, 2012).

The non – significant finding for affective engagement aligns with



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the hypothesis and qualitative data , suggesting that while methodology sets the stage , the instructor's empathy, enthusiasm and ability to create a supportive environment are more potent drivers of emotional connection to the course (Fredricks et al., 2004).

The qualitative findings crucially explain the mechanisms behind the numbers. The theme of Clarity and Structure suggests that any methodological choice can succeed or fail based on its implementation. A poorly structured PBL exercise is worse than a well - structured lecture. The themes of Social Learning and Self - Regulation highlight the inherent trade- offs and individual differences in engagement. Active methodologies promise higher engagement but also introduce new potential barriers (group conflict , need for autonomy) that can undermine their benefits if not carefully managed.

The Perceived Relevance theme directly links to the high cognitive engagement in PBL, supporting constructivist learning theories that posit knowledge is built most effectively through authentic , meaningful tasks.

5.1 Theoretical and Practical Implications Theoretically , this study reinforces the need to treat engagement as a multidimensional construct. Reporting a single “engagement” score obscures important nuances. It also highlights the interaction between method and individual student characteristics (e.g., self - regulation skills).

Practically, this research offers actionable guidance for educators and designers:

1. Align Method with Goal : Choose PBL to target cognitive skills like critical thinking. Choose FC to increase active participation and skill practice.
2. Design for Implementation: Invest significant effort in creating crystal clear instructions , structured guidelines for collaboration and scaffolding for self - regulation , especially in active learning environments.
3. Assess Holistically :Use multiple methods to gauge engagement (e.g., surveys, LMS analytics , classroom observations) to get a complete picture.



5.2 Limitations and Future Research Directions : This study has several limitations. The use of a convenience sample from one university limits generalizability. The quasi experimental design means we cannot fully claim causality as students were not randomly assigned to methods , pre – existing course or instructor differences could be confounding variables. Self – report data, though correlated with behavioral metrics is still subject to bias.

Future research should:

Employ a longitudinal, randomized controlled trial design.

Investigate the role of individual differences (e.g., personality, prior knowledge) as moderators in the relationship between method and engagement.

Explore the specific design principles (e.g., type of scaffolding, group size) that maximize the benefits and minimize the drawbacks of active learning methods.

6. Conclusion

This mixed–methods study demonstrates that the relationship between methodological choice and student engagement is significant ,complex, and multidimensional. There is no “best” method ; each pedagogical approach carries a unique profile of strengths and weaknesses across the cognitive, affective and behavioral domains. The flipped classroom prompts action, problem–based learning challenges thinking and both, like the traditional lecture, rely on the instructor’s skill to foster a positive emotional climate. The key to unlocking student engagement lies not in adopting the latest trend but in making a deliberate methodological choice that is aligned with core learning objectives and is implemented with exceptional clarity, support and awareness of the student experience. Effective teaching is, therefore, a strategic and reflective practice of design and facilitation.

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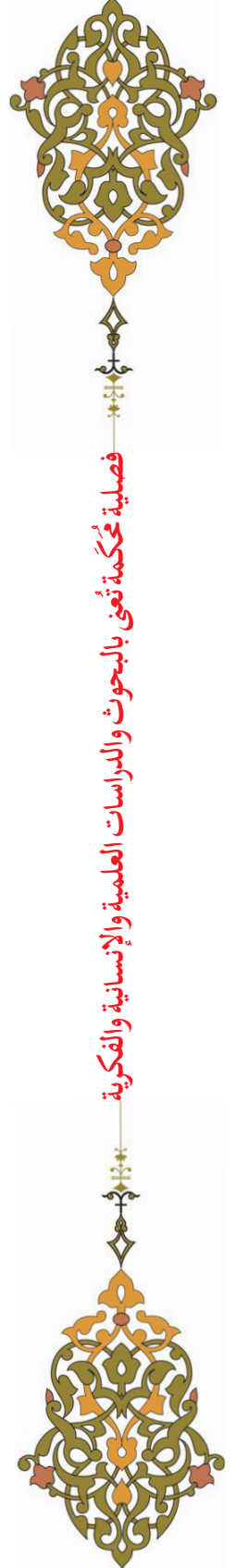
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