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Exploring the Relationship between Classroom Arrangement and Students' Performance in Cambodian Higher Education: The Role of Self-Regulation

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ABSTRACT

This study investigates the impact of classroom arrangement on students' academic performance in Cambodian higher education, with particular emphasis on the mediating role of self-regulation. A quantitative approach was adopted, using data collected from 320 university lecturers through a structured questionnaire. Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to test the proposed model. The findings reveal that classroom arrangement plays a significant role in shaping students' self-regulation and academic performance. Moreover, self-regulation not only contributes directly to students' academic success but also mediates the relationship between classroom arrangement and students' performance. These results highlight the importance of both classroom arrangement and students' self-regulatory abilities in achieving positive educational outcomes. The study suggests that universities should prioritize effective classroom design and implement strategies that strengthen self-regulation to enhance overall learning achievement.

Keywords: Cambodian Universities; Classroom Arrangement; Mediating Effect; Physical Learning Space; Students' Performance

Background

In higher education, the learning environment, particularly classroom arrangement, plays a crucial role in influencing students' academic performance and success. In Cambodia, the higher education sector has been rapidly evolving, especially after the COVID-19 pandemic, with more universities, higher enrollment, and expanded academic programs reflecting a national effort to improve tertiary education quality. However, the effectiveness of these programs depends not only on their availability but also on how the learning environment supports student engagement and achievement. Classroom arrangement, including seating layout, space utilization, and the integration of technology, significantly affects student interaction, participation, and comfort, all of which contribute to better learning outcomes. Research shows that well-organized and flexible classroom settings foster collaboration and active learning, which are essential for developing critical thinking and problem-solving skills. Additionally, self-regulation can mediate the impact of classroom environments by helping students adapt and thrive academically. Despite efforts by Cambodian institutions to improve physical learning spaces and faculty quality, limited research exists on how classroom arrangements specifically influence student success. Recognizing how learning environments influence student outcomes is crucial for educators and policymakers striving to design supportive educational contexts that foster engagement, motivation, and overall academic success (Aristovnik et al., 2023; Shams et al., 2022).

Higher education institutions across the globe have been adapting to an increasingly interconnected and technology-driven environment, a transition that was significantly accelerated by the COVID-19 pandemic, which prompted widespread adoption of online and blended learning modalities (Harper et al., 2024). This transformation has profoundly affected the learning environment, particularly in terms of classroom design, which now encompasses not only traditional physical spaces but also virtual and hybrid formats. Well-designed learning environments, whether in-person or online, are essential for promoting student engagement, collaboration, and academic achievement (Nikolopoulou & Zacharis, 2023). Thoughtful organization of learning spaces supports interaction, fosters motivation, and enhances the overall educational experience (Aristovnik et al., 2023; Bashir et al., 2021). In Cambodia, similar trends have emerged as universities transition to blended learning models post-pandemic. Cambodian higher education institutions have faced challenges such as limited internet access and adapting teaching methods but continue to prioritize improving classroom dynamics to support student learning (Heng & Sol, 2021). Research highlights that flexible and thoughtfully designed classroom environment accommodate diverse learning styles and facilitate active participation, which are vital for student success (Saykılı, 2019). Moreover, combining physical and virtual classroom arrangements enables more personalized and collaborative learning experiences, helping students better engage with course content and develop critical skills (Onah et al., 2022). As Cambodian institutions strive to enhance student performance, focusing on classroom arrangement within blended learning frameworks appears essential for creating supportive, effective learning environments that respond to both technological advances and students' needs. This study aims to explore how classroom arrangement can enhance student engagement, collaboration, and active learning, thereby supporting the development of essential knowledge and skills. Additionally, this study aims to explore how students' self-regulation abilities mediate the relationship between classroom arrangement and students' performance, providing insight into the underlying mechanisms that connect learning environments with student performance.

Literature Review

Transactional Distance Theory explains how the physical and psychological gap between instructors and students can affect learning, suggesting that reducing this distance through effective classroom arrangement can boost engagement and outcomes (Moore, 1993). Self-Determination Theory (SDT) emphasizes that fulfilling students' basic psychological needs for autonomy, competence, and relatedness

fosters intrinsic motivation, which in turn supports self-regulated learning. Well-designed classrooms can facilitate this process by providing flexible seating, collaborative spaces, and opportunities for choice, thereby enhancing students' engagement, motivation, and ability to regulate their own learning (Ryan & Deci, 2000). Research supports these ideas, showing that student-centered classroom layouts promote intrinsic motivation, focus, and active participation. For example, flexible seating allows students to select environments that suit their learning preferences, enhancing self-regulation and comfort. Moreover, classrooms designed to reduce distractions and incorporate interactive elements foster better engagement and academic performance. Such environments not only improve focus and communication skills but also help students feel more in control and connected, ultimately contributing to higher achievement (Baepler et al., 2014; Peng et al., 2022).

Bandura's Social Cognitive Theory (1986) emphasizes the dynamic interaction between personal factors, environmental influences, and behavior, highlighting how observational learning and self-regulation are crucial for achieving goals such as academic success. Classroom arrangements, as part of the learning environment, can significantly influence students' ability to regulate their learning and apply strategies effectively. Similarly, Zimmerman (2000) explains that self-regulation is a dynamic process in which students set goals, monitor their progress, and adjust strategies to enhance learning outcomes, with classroom design playing a key role in supporting and facilitating these processes. Research supports this connection, showing that organized and flexible classroom environments, such as those with clear visual cues, designated learning zones, and adaptable seating, enhance student engagement and self-regulation (Karabatak & Polat, 2020). Classrooms that foster autonomy and provide motivating tasks help students develop persistence and goal-setting skills, promoting better academic outcomes. This suggests that thoughtful physical arrangements do not just manage classroom order but actively empower students' motivation and lifelong learning skills (Hattie, 2023).

Research consistently shows that these self-regulatory behaviors are strong predictors of academic performance in higher education. For example, Zimmerman & Martinez-Pons (1988) demonstrated that students who actively set goals and monitor their progress tend to achieve better academically. Similarly, Credé & Kuncel (2008) found a significant positive relationship between self-regulation and academic success across diverse studies, highlighting the importance of self-regulatory skills for effective learning and achievement in college settings. These environmental factors influence students' self-regulation, enabling them to manage their learning behaviors effectively. Complementing this, Pekrun (2006) emphasizes the role of perceived control and task value in academic achievement, suggesting that self-regulation helps students maintain motivation by managing their learning even in challenging environments. Research supports the crucial role of self-regulation in enhancing academic outcomes; students who actively engage in goal setting, monitoring, and reflection tend to perform better academically. Jin et al. (2023) indicate that well-structured online learning environments, particularly those incorporating supportive tools and artificial intelligence applications, can enhance students' cognitive and metacognitive self-regulation, thereby promoting higher academic achievement.

Hypotheses and Theoretical Framework

H1: Classroom arrangement has an influence on students' performance of higher education in Cambodia

H2: Classroom arrangement has an influence on self-regulation in Cambodian higher education institutions.

H3: Self-regulation has an influence on students' performance of higher education in Cambodia.

H4: Self-regulation mediates the relationship between classroom arrangement and students' performance of higher education in Cambodia.

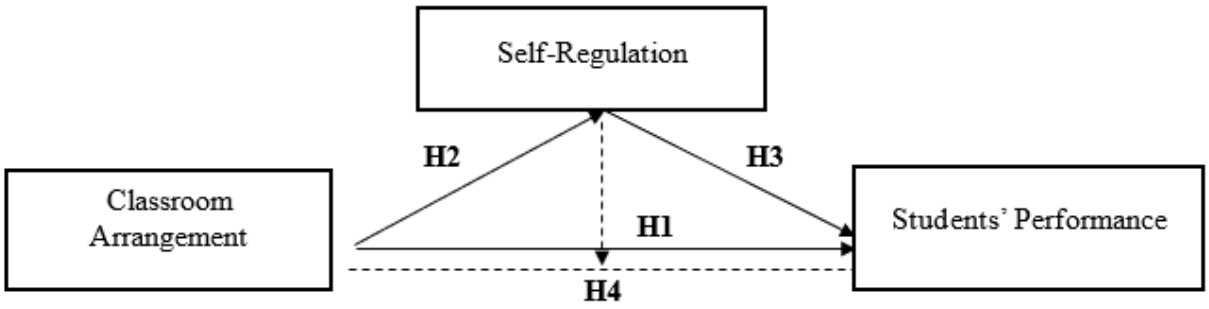

Figure 1: Theoretical Framework

Methods

Sampling and Data Collection

To achieve the objectives outlined above, the most appropriate approach is to conduct descriptive research using quantitative methods. Consistent with the results reported by Kassab et al. (2024), it is advised to prioritize quantitative methodologies over the traditionally dominant qualitative approaches. Moreover, Creswell & Guetterman (2024) described the population as a group of individuals who share the same characteristics and other common features that the researcher can identify and study. Consequently, the present research focuses on lecturers from selected public and private universities in Cambodia.

In higher education research, lecturers are often considered reliable informants for student performance for several reasons. First, lecturers directly assess and evaluate students through assignments, exams, and overall course performance, giving them firsthand knowledge of students' academic outcomes (Karaman, 2024). Using tools at the instructor level, such as rubrics, standardized assessments, or instructor evaluations, can provide more objective, consistent data compared to self-reports from students, which may be subject to bias (Simon, *et al*., 2024). Moreover, educators can observe patterns across entire cohorts, such as engagement trends, dropout tendencies, or average GPA distributions, offering a broader and more stable basis for evaluating student performance at the group or class level (Karaman, 2024; Simon et al., 2024). Finally, in contexts where directly surveying students may yield low response rates or incomplete data, lecturer-based assessment data can be completer and more reliable for statistical analysis and institutional decision-making (Simon et al., 2024).

In this study, the required sample size was determined using Krejcie & Morgan (1970) sample size table, which indicates that a minimum of 322 respondents is appropriate for a population of 2,000 at a 95% confidence level and a 5% margin of error. Since survey research rarely achieves a 100 percent response rate, especially when distributed through email or similar channels, it is standard practice to distribute more questionnaires than the minimum needed. Following the recommendations of (Bartlett, Kotrlik, & Higgins, 2001), who advise oversampling by up to 50 percent to compensate for nonresponse, the study expanded the distribution to a maximum of 483 potential participants. Ultimately, 405 responses were obtained, falling within the acceptable range between the minimum required sample of 322 and the oversampling upper limit of 483.

Meanwhile, the questionnaire was meticulously developed using validated items corresponding to the study's key constructs. A pilot study was carried out to evaluate the instrument's internal consistency and reliability. The results revealed that Cronbach's alpha coefficients for many of the constructs ranged from 0.708 to 0.911, thereby exceeding the commonly accepted threshold of 0.70 (Nunnally, 1978). Following the pilot validation, hard copies of the finalized questionnaires were distributed to all academic staff at selected public and private universities in Cambodia to ensure efficient and effective data collection. In total, 405 hard-copy questionnaires were distributed to academic staff across selected public and private higher education institutions in Cambodia. This effort yielded 347 returned surveys, representing a

response rate of approximately 85.7%. During the data screening process, 27 questionnaires were removed because they contained excessively incomplete responses. Consequently, 320 fully completed and valid questionnaires were retained for subsequent analysis. Thus, the overall response rate was 79%, which is considered acceptable for quantitative analysis. The demographic profile of the respondents is outlined in Table 1.

Table 1: The Demographic Characteristics of the Respondents

Factors	***Classification***	***Repetition***	***Proportion***
Gender	Female	34	10.6
	Male	286	89.4
Age	Below 30yrs	18	5.6
	31-40yrs	52	16.3
	41-50yrs	162	50.6
	51-60yrs	81	25.3
	61yrs and above	7	2.2
Academic Qualification	MSc.	271	84.7
	PhD	49	15.3
Working Experience	Below 5yrs	28	8.8
	6 – 10yrs	47	14.7
	11 – 15yrs	166	51.9
	16 – 20yrs	68	21.3
	Above 20yrs	11	3.4
N		***320***	

Measurement

A five-point Likert scale, spanning from 1 (strongly disagree) to 5 (strongly agree), was applied to measure the constructions explored in the study. The questionnaire was divided into six sections. Items addressing classroom arrangement were designed to reflect the technological context, drawing on established frameworks. Self-regulation measures were adapted from previously validated scales, while student performance was assessed using multiple dimensions based on prior educational research.

Data Analysis

SmartPLS software was utilized in the present study to evaluate the proposed research framework, as it is a widely adopted tool for quantitative data analysis. Specifically, SmartPLS facilitated the assessment of the structural model, enabling the examination of the model's predictive capacity and the relationships among the constructs (Henseler et al., 2014; Hu & Bentler, 1999). In this study, SmartPLS 3.0 was employed to estimate both the measurement model (external model), which involved evaluating constructs' consistency and strength, and the structural model (internal model), which assessed the hypothesized relationships between latent variables.

Results & Discussion

Measurement Model Evaluation

Table 2, the reliability and validity of the constructs were confirmed using Cronbach's alpha, composite reliability (CR), AVE, and discriminant validity, following (Henseler et al., 2014; Hu & Bentler, 1999). All constructs demonstrated strong internal consistency (α and CR > 0.90) and convergent validity (AVE > 0.63). Items with loadings between 0.7 and 0.9 were kept in the model.

Table 2: Construct Reliability and Validity

Construct	*Items*	*Loadings*	*Cronbach Alpha*	*Composite Reliability*	*Average Variance Extracted*
Classroom Arrangement	CA1	0.801	0.943	0.951	0.638
	CA10	0.847			
	CA11	0.773			
	CA2	0.855			
	CA3	0.846			
	CA4	0.877			
	CA5	0.762			
	CA6	0.714			
	CA7	0.793			
	CA8	0.757			
Students' Performance	SP1	0.883	0.971	0.974	0.698
	SP10	0.901			
	SP11	0.853			
	SP12	0.903			
	SP14	0.904			
	SP15	0.904			
	SP16	0.802			
	SP17	0.889			
	SP2	0.746			
	SP3	0.718			
	SP4	0.736			
	SP5	0.722			
	SP6	0.743			
	SP7	0.888			
	SP8	0.901			
	SP9	0.827			
Self-Regulation	SR1	0.913	0.931	0.946	0.745
	SR2	0.901			
	SR3	0.822			
	SR4	0.793			
	SR5	0.822			
	SR6	0.918			

SP13 was removed from the analysis. Following (Ramayah et al., 2017), construct reliability and convergent validity are evaluated using factor loadings (>0.60), Cronbach's Alpha (CA > 0.70), composite reliability (CR > 0.70), and average variance extracted (AVE > 0.50). As shown in Table 2, all constructs exceeded these thresholds, confirming convergent validity. CR and AVE were also used to evaluate internal consistency, with all constructs meeting the recommended values, indicating that the measurement model is reliable and internally consistent (Hair et al., 2017).

Table 3: Latent Variable Correlations (Fornel-Larcker Criterion)

Constructs	***CA***	***SR***	***SP***
Classroom Arrangement (CA)	*0.799*		
Self-Regulation (SR)	0.405	*0.863*	
Students' Performance (SP)	0.329	0.333	*0.836*

Table 4's discriminant validity was further assessed using the Heterotrait–Monotrait ratio (HTMT); all values were below the recommended threshold of 0.85, confirming adequate discriminant validity among the constructs (Henseler et al., 2015). In particular, the SR–CA (0.428), SP–CA (0.340), and SP–SR (0.348) coefficients all exceed the threshold for inter-construct separation, thereby providing strong evidence of discriminant validity in the measurement model.

Table 4: Discriminant Validity (Heterotrait-Monotrait Ratio - HTMT)

Constructs	***CA***	***SR***	***SP***
Classroom Arrangement (CA)			
Self-Regulation (SR)	0.428		
Students' Performance (SP)	0.340	0.348	

Structural Model Evaluation

After confirming the validity of the measurement model, the R^2 values were examined to determine how well the exogenous variables explain the endogenous constructs. Higher R^2 values reflect greater explanatory power. As noted by Chin (1998), R^2 values above 0.67 are considered substantial, values between 0.33 and 0.67 are viewed as moderate, and those ranging from 0.19 to 0.33 are regarded as weak and R^2 values below 0.19 are undesirable. Table 5 presents the structural model indicators. The R^2 values of 15.6% for students' performance and 16.4% for self-regulation indicate that the model explains a modest portion of variance in these outcomes. While these values suggest some predictive ability, additional factors not included in the model likely play a substantial role in determining students' performance and self-regulation.

Table 5: Coefficient of Determination (R Square)

Constructs	**R-square**	**R-square adjusted**
Self-Regulation	0.164	0.161
Students' Performance	0.156	0.151

Moreover, the f^2 effect sizes were calculated to determine the contribution of each exogenous variable to the R^2 value of the endogenous constructs, with thresholds of 0.02, 0.15, and 0.35 indicating small, medium, and large effects, respectively (Cohen, 1988). The (f^2) effect size analysis reveals that self-regulation have a small impact on students' performance ($f^2 = 0.057$), while classroom arrangement has only a small effect ($f^2 = 0.053$) on Students' Performance. Additionally, classroom Arrangement exerts a moderate effect on self-regulation ($f^2 = 0.196$) in Table 6.

Table 6: Effect Sizes (f2) Analaysis

Students'Peformance	***Effect Size***	***Decisions***
Classroom Arrangement	0.053	Small
Self-Regulation	0.057	Small
Sefl-Regulation	***Effect Size***	***Decisions***
Classroom Arrangement	0.196	Moderate

Q^2 values, calculated via the blindfolding procedure, serve to assess the model's predictive relevance; values above zero denote adequate predictive accuracy (Henseler et al., 2014; Hu & Bentler, 1999). In this

study, the Q^2 results for the endogenous constructs confirm that the model possesses predictive relevance. Specifically, the Q^2 for students' performance is 0.106, reflecting a medium level of predictive relevance. The Q^2 for self-regulation is 0.119, suggesting a moderate to strong predictive power. Since both values exceed the threshold of Zero, it can be concluded that the model exhibits acceptable predictive relevance for these constructs in Table 7.

Table 7: Construct Cross Validated Redundancy (Q2)

Constructs	***SSE***	***SSO***	***1-SSE/SSO***
Self-Regulation	1,920.000	1691.269	0.119
Students' Performance	5,120.000	4577.420	0.106

Note: SSO - Systematic Sources of Output; SSE - Systematic Sources of Error

Thus, SRMR values for both the saturated model and the estimated model are both 0.077 below the recommended threshold of 0.10 it can be concluded that the model used in this study has a good fit (Henseler et al., 2014; Hu & Bentler, 1999). Table 8 presents an overview of the structural model's indicators.

Table 8: Goodness of Fit of The Model

Item	***Saturated Model***	***Estimated Model***
SRMR	0.077	0.077
d_ULS	3.298	3.298
d_G	6.768	6.768
Chi-Square	7,405.214	7,405.214
NFI	0.559	0.559

Hypothesis Testing

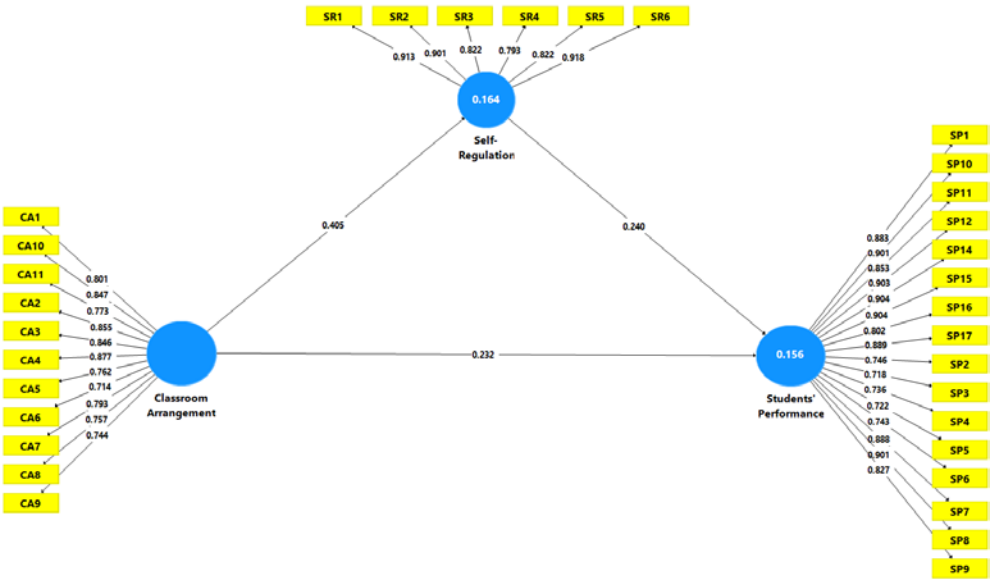

Figure 2: Path Model Significant

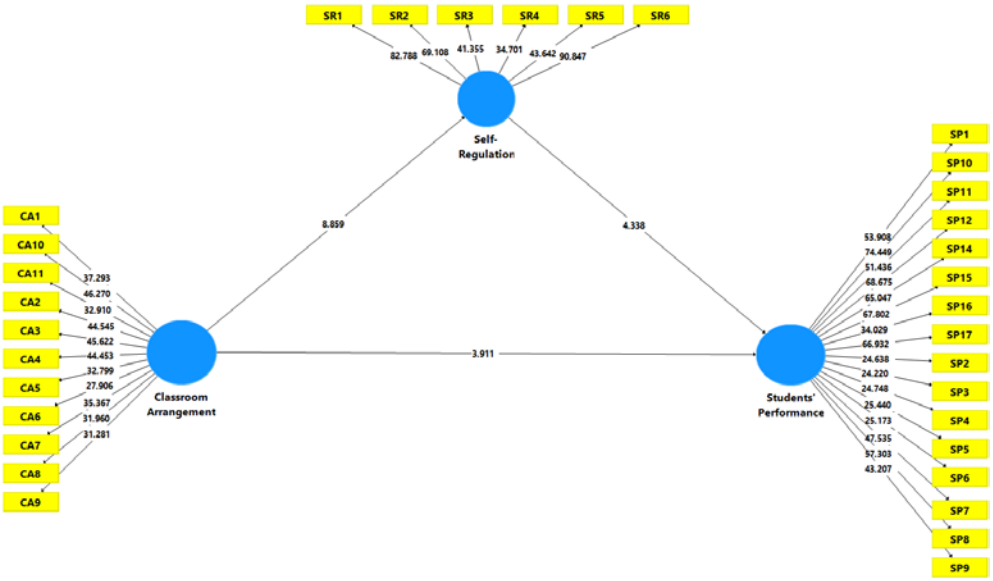

Figure 3: Path Model Results of Mediation

This study explored the connection among classroom arrangement, self-regulation, and academic performance of students in Cambodian higher education. Employing Partial Least Squares Structural Equation Modeling (PLS-SEM), the findings confirmed all four hypotheses (H1–H4), demonstrating that classroom arrangement has both direct and indirect effects on students' academic outcomes.

The findings support H1, indicating that classroom arrangement exerts a significantly influence on the students' performance of higher education students in Cambodia ($\beta = 0.234$, $t = 3.850$, $p = 0.000$). It aligns with the meta-analytic findings of (Yang, Xijun & Jiahui, 2023), who emphasized that well-designed smart classrooms could enhance student engagement and academic achievement. Together, these findings underscore the importance of investing in effective classroom design as a strategic component of educational quality improvement in higher education.

The findings also provide strong support for H2, demonstrating that classroom arrangement significantly influences students' self-regulation ($\beta = 0.408$, $t = 8.677$, $p = 0.000$). These results align with (Mantooth, Usher, & Love, 2021), who emphasized that environmental factors within classrooms—such as spatial design, organization, and comfort—can shape students' self-efficacy and, in turn, their capacity for self-regulation. This underscores the importance of learning space design as a foundational element in promoting effective learner autonomy and academic engagement.

The statistically significant effect of self-regulation on student performance ($\beta = 0.242$, $t = 4.018$, $p = 0.000$) provides support for H3. This finding is consistent with (Smadi, Masri, & Maharmah, 2024), who identified a positive relationship between the application of self-regulated learning strategies and academic success among higher education students. The results reinforce the pivotal role of self-regulation as a cognitive and motivational mechanism that enables students to manage their learning processes effectively.

The findings offer empirical support for H4, revealing a statistically significant indirect effect ($\beta = 0.099$, $t = 3.487$, $p = 0.001$). This indicates that the positive impact of classroom arrangement on students' performance is partially mediated by students' self-regulation. These findings are consistent with Jung et al. (2022), who showed that instructional models incorporating regulated learning foster self-regulatory behaviors that, in turn, enhance academic performance. This evidence reinforces the importance of well-designed learning environments in promoting both the cognitive and behavioral components essential for student success.

Table 9: Direct and Indirect Effect Hypotheses Testing

Hypothesis	*Coef.*	*Se*	*T value*	*P values*	*Decision*
Classroom Arrangement -> Students' Performance	0.234	0.060	3.850	0.000	*Supported*
Classroom Arrangement -> Self-Regulation	0.408	0.047	8.677	0.000	*Supported*
Self-Regulation -> Students' Performance	0.242	0.060	4.018	0.000	*Supported*
Classroom Arrangement -> Self-Regulation -> Students' Performance	0.099	0.028	3.487	0.001	*Supported*

Note: Coef. = Coefficient; Se = standard error.

Conclusion

Beyond statistical validation, the relationship between classroom arrangement and self-regulation can be understood through cognitive and environmental mechanisms. Well-structured learning spaces reduce distractions and provide visual cues, supporting students' organization, monitoring, and management of learning strategies. This aligns with Social Cognitive Theory, emphasizing the reciprocal influence of environment and self-regulatory behavior. Thoughtful layouts also foster autonomy and engagement, encouraging students to take responsibility for their learning. Cultural factors shape these effects; in many Asian higher education contexts, including Cambodia, teacher-centered traditions may limit self-initiated regulation. Classrooms that provide structure, clarity, and collaborative opportunities may have a stronger impact on self-regulation, as cultural norms influence how students engage in learning. Recognizing these factors explains the meaningful effects of classroom arrangement and underscores the importance of optimizing learning environments to support self-regulatory development. Despite these insights, the study has some limitations. First, the research was conducted within a specific cultural and educational context in Cambodia, which may limit the generalizability of the results to other regions or education systems. Second, the study relies on self-reported measures of self-regulation, which may introduce bias. Future research could address these limitations by including diverse contexts, using longitudinal designs, and employing objective measures of self-regulation and performance.

Declarations

Ethics Approval and Consent to Participate: Informed consent was secured from all participants prior to data collection. Participation was completely voluntary, and confidentiality of their responses was strictly upheld throughout the study.

Conflicts of Interest: Not Applicable.

Acknowledgement: Sincere thanks are offered to all participants for their valuable contributions to the study.

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