Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 9, 731-741
2025
Publisher: Learning Gate
DOI: 10.55214/2576-8484.v9i9.9952

The influence of curriculum design on university students' academic performance in Cambodia: Exploring the mediating role of self-regulation

Chumneanh Lork[1*], Dhakir Abbas Ali[2]
[1,2]School of Business and Management, Lincoln University College, Malaysia; lork@lincoln.edu.my (C.L.)
drdhakir@lincoln.edu.my (D.A.A.)

Abstract: This study investigates the influence of curriculum design on university students' academic performance in Cambodian higher education, emphasizing the mediating role of self-regulation. A quantitative research design was adopted, collecting data from 320 lecturers across public and private universities. Using SmartPLS (PLS-SEM), the measurement model demonstrated strong reliability (Cronbach's $\alpha > 0.90$) and validity (AVE > 0.60). The structural model explained 15.6% of the variance in self-regulation and 11.8% in students' performance, with Q^2 values above zero, confirming predictive relevance. Curriculum design did not significantly affect students' performance directly ($\beta = 0.099$, $t = 1.655$, $p = 0.099$) but had a strong positive effect on self-regulation ($\beta = 0.405$, $t = 8.580$, $p = 0.000$). Self-regulation significantly enhanced students' performance ($\beta = 0.296$, $t = 5.420$, $p = 0.000$) and mediated the relationship between curriculum design and students' performance ($\beta = 0.120$, $t = 4.370$, $p = 0.000$). The results suggest that curriculum design indirectly improves academic outcomes by fostering self-regulatory skills. These findings highlight the need for learner-centered, goal-oriented curricula that actively cultivate self-regulation, empowering students to manage their learning processes and achieve better academic performance.

Keywords: *Academic performance, Cambodian universities, Curriculum design, Mediating effect, Self-regulation.*

1. Introduction

In Cambodia's evolving higher education landscape, curriculum design plays a crucial role in shaping students' academic success. As universities expand and enrollment grows post-pandemic, it is increasingly clear that the quality of education depends not only on institutional growth but also on how well curricula are structured to meet students' learning needs. Effective curriculum design integrates clear learning objectives, relevant content, appropriate teaching method, and assessment strategies that align with real-world competencies. This cultivates a dynamic and nurturing learning atmosphere that enhances student motivation and facilitates skill growth. Research highlights that thoughtfully designed curriculum can enhance student engagement and academic achievement by providing coherent and meaningful learning experiences [1]. Furthermore, curriculum design influences students' ability to self-regulate their learning—setting goals, monitoring progress, and adjusting strategies—which is essential for academic success in higher education [2, 3]. Despite efforts by Cambodian institutions to improve educational quality through better infrastructure and qualified faculty, there remains limited research on how curriculum design specifically impacts student performance in Cambodia. Understanding this relationship, especially the role of self-regulation as a mediator, is vital for informing policy and practice to strengthen higher education outcomes in the country.

Curriculum design plays a crucial role in shaping the quality of higher education, particularly in the evolving learning environments influenced by technological advancements and global trends [4]. In the

History: Received: 17 June 2025; Revised: 11 August 2025; Accepted: 14 August 2025; Published: 12 September 2025
* Correspondence: lork@lincoln.edu.my

context of Cambodia's higher education, recent shifts towards blended learning—combining traditional face-to-face instruction with online components—have highlighted the importance of well-structured curricula that support diverse learning modes and student needs. Effective curriculum design integrates clear learning objectives, relevant content, varied teaching methods, and appropriate assessments to foster deeper understanding and engagement [5]. It also accommodates flexibility, allowing students to access materials asynchronously while benefiting from interactive, collaborative activities both online and in-class. This adaptability is vital in a post-pandemic era where institutions strive to enhance student performance despite challenges such as limited resources and digital divides. Moreover, a thoughtfully designed curriculum supports the development of critical thinking and self-regulated learning, essential skills for student success [6]. In Cambodia, efforts to improve curriculum design coincide with broader educational reforms aimed at raising academic standards and addressing disparities in access and quality [7]. By aligning curriculum development with emerging pedagogical practices and technological integration, Cambodian higher education institutions can better prepare students for a competitive, globalized world. Overall, prioritizing curriculum design that is responsive to changing learning environments and student diversity is key to advancing educational outcomes and ensuring sustainable improvements in student performance. This study aims to investigate the effect of curriculum design on the academic achievement of higher education students in Cambodia. Additionally, the study aims to explore the mediating role of students' self-regulation abilities in this relationship, investigating how students' capacity to manage their own learning influences the effectiveness of curriculum design.

2. Literature Review

Transactional distance theory highlights how both physical and psychological gaps between learners and instructors can affect learning effectiveness, suggesting that well-structured curricula help reduce this distance and improve engagement [8]. Similarly, self-determination theory emphasizes that fostering autonomy, competence, and relatedness within a curriculum enhances students' intrinsic motivation and performance [9, 10]. Research supports that thoughtful curriculum design—aligning learning objectives, assessment, and teaching method—positively influences academic success. For instance [11, 12] demonstrated that constructive alignment promotes better student achievement. Additionally, integrating formative assessments and timely feedback further supports learning progress. Effective course designs, which blend traditional and digital approaches, enhance student engagement and satisfaction, crucial for performance in today's education landscape. These findings underscore that curriculum design is fundamental in shaping students' learning outcomes and overall academic success.

Zimmerman's Social Cognitive Model of Self-Regulation highlights the interaction between personal factors, environmental influences, and behavior in learning. It emphasizes that self-regulation involves goal setting, self-monitoring, evaluation, and reinforcement, all of which can be supported through effective curriculum design [13]. A well-structured curriculum provides clear objectives, scaffolded activities, and opportunities for reflection and feedback, fostering students' ability to regulate their own learning. Bandura's Social Cognitive Theory also underscores the importance of observational learning and self-efficacy, suggesting that curricula incorporating modeling and self-regulatory strategies can enhance student motivation and achievement [14]. Empirical evidence supports this, as interventions that embed self-regulated learning techniques within curricula have been shown to improve students' self-regulation skills and academic performance. These findings reinforce that curriculum design plays a crucial role in promoting self-regulation, which is key to effective learning and academic success.

Social Cognitive Theory (SCT) highlights the interaction between personal factors, environment, and behavior, emphasizing self-regulation through processes like self-monitoring, evaluation, and reinforcement. Similarly, Self-Determination Theory (SDT) identifies autonomy, competence, and relatedness as essential psychological needs that drive motivation and promote self-regulated behavior [15]. In higher education, self-regulation involves setting goals, monitoring progress, and adapting

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 9: 731-741, 2025
DOI: 10.55214/2576-8484.v9i9.9952

strategies to achieve academic success. Empirical research supports this connection; for example [16] found that self-regulatory behaviors positively predicted college students' academic performance. Furthermore, a meta-analysis of more than 100 studies [17] confirmed a robust association between self-regulation and academic performance across various educational settings. These results highlight the essential importance of self-regulation in promoting academic success among higher education students.

Curriculum design plays a crucial role in shaping higher education students' performance by influencing their ability to self-regulate learning. Students learn through observation and modeling within their learning environment, where curriculum structure, teaching method, and technology use significantly affect their engagement and motivation [12, 18]. Self-regulation enables students to set goals, monitor progress, and adapt strategies, fostering autonomy and persistence despite challenges. Research shows that well-designed curricula that promote autonomy and support self-regulatory behaviors enhance academic achievement [16]. Specifically, when curricula provide clear goals, varied learning activities, and meaningful feedback, students are better equipped to manage their learning processes effectively. Thus, curriculum design not only impacts cognitive engagement but also cultivates students' self-regulatory skills, which are essential for sustained academic success in higher education settings.

2.1. Hypotheses and Research Framework

- H_1: Curriculum design has a significantly influence on students' performance of higher education in Cambodia.
- H_2: Curriculum design has a significantly influence on self-regulation in Cambodian higher education institutions.
- H_3: Self-regulation has a significantly influence on students' performance of higher education in Cambodia.
- H_4: Self-regulation significantly mediates the relationship between curriculum design and students' performance of higher education in Cambodia.

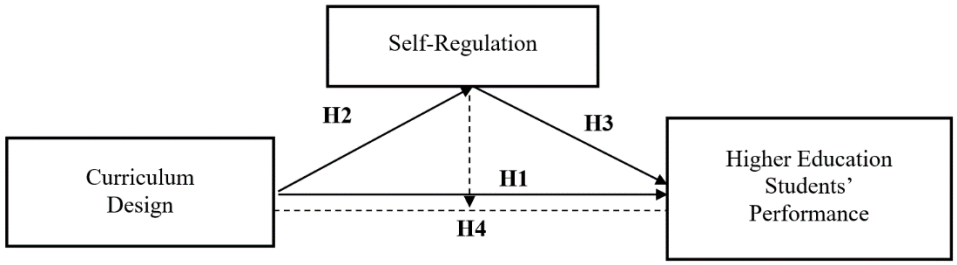

Figure 1.
Research Framework

3. Methodology

3.1. Sampling and Data Collection

A research design serves as a structured and methodical plan that guides the entire research process, ensuring consistency between the research questions, theoretical foundation, hypotheses (if any), and the chosen methodology. It acts as a blueprint that directs how data will be collected, measured, analyzed, and interpreted, thereby upholding the study's validity, reliability, and ethical standards [19]. For this study, a descriptive research design using quantitative methods was deemed most appropriate. In alignment with [20] the preference for quantitative over qualitative methods supports a more objective and measurable approach. The target population consists of lecturers from selected public universities in Cambodia, chosen based on their relevance and accessibility. Based on the

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sample size guidelines proposed by Krejcie and Morgan [21] the appropriate number of participants for a population of 2,000 was adhered to in this study.

A structured questionnaire was designed using previously validated items aligned with the study's main constructs. A pilot study was undertaken to evaluate the instrument's reliability, with Cronbach's alpha values ranging from 0.708 to 0.911, all exceeding the generally accepted minimum threshold of 0.70 [22]. After finalizing the instrument, printed questionnaires were distributed to academic staff in selected public and private universities. A total of 405 questionnaires were handed out, and 347 were successfully completed and returned, yielding an initial response rate of 85.7%. After excluding 27 incomplete responses, 320 valid surveys remained, resulting in a final usable response rate of 79% in Table 1, which is considered acceptable for quantitative research.

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**	

3.2. Measurement

A five-point Likert scale, spanning from 1 (strongly disagree) to 5 (strongly agree), was applied to measure the constructs explored in the study. The questionnaire was organized into six sections. Items addressing curriculum design were created to evaluate the technological context, based on adaptations of existing measurement tools. The section on self-regulation included items modified from established frameworks, while student performance was assessed using four key dimensions drawn from prior models and research.

3.3. 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 was utilized to evaluate the structural model, allowing for the analysis of both the model's predictive capability and the interrelationships among the constructs [23, 24].

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.

4. Result and Discussion

4.1. 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 [23, 24]. All constructs

Edelweiss Applied Science and Technology
ISSN: 2576-8484
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demonstrated strong internal consistency (α and CR > 0.90) and convergent validity (AVE > 0.66). 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
Curriculum Design	CD1	0.826	0.943	0.951	0.661
	CD10	0.779			
	CD2	0.854			
	CD3	0.776			
	CD4	0.832			
	CD5	0.857			
	CD6	0.776			
	CD7	0.835			
	CD8	0.808			
	CD9	0.778			
Students' Performance	SP1	0.885	0.931	0.946	0.745
	SP10	0.904			
	SP11	0.851			
	SP12	0.907			
	SP14	0.908			
	SP15	0.908			
	SP16	0.801			
	SP17	0.892			
	SP2	0.742			
	SP3	0.712			
	SP4	0.732			
	SP5	0.714			
	SP6	0.739			
	SP7	0.891			
	SP8	0.905			
	SP9	0.826			
Self-Regulation	SR1	0.916	0.971	0.974	0.699
	SR2	0.902			
	SR3	0.821			
	SR4	0.790			
	SR5	0.820			
	SR6	0.920			

Table 3 shows that discriminant validity was confirmed using the Fornell–Larcker criterion, demonstrating that each construct is empirically distinct. The square root of the AVE for each construct curriculum design (0.813), self-regulation (0.863), and students' performance (0.836) exceeded its correlations with other constructs, meeting the threshold proposed by Fornell and Larcker [25]. These results support the discriminant validity and integrity of the measurement model [23, 24].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
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Table 3.
Latent Variable Correlations (Fornel-Larcker Criterion).

Constructs	CD	SR	SP
Curriculum Design (CD)	0.813		
Self-Regulation (SR)	0.395	0.863	
Students' Performance (SP)	0.214	0.332	0.836

Table 4, discriminant validity was further supported using the Heterotrait-Monotrait Ratio (HTMT), with all values below the 0.90 threshold [26]. Specifically, SR–CD (0.411), SP–CD (0.218), and SP–SR (0.348) indicate clear distinction among constructs, confirming strong discriminant validity in the measurement model.

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

Constructs	CD	SR	SP
Curriculum Design (CD)			
Self-Regulation (SR)	0.411		
Students' Performance (SP)	0.218	0.348	

4.2. Structural Model Evaluation

After validating the measurement model, the R^2 values were examined to determine how well the endogenous constructs are explained by the exogenous variables. Higher R^2 values reflect greater explanatory power. As noted by Chin [27] R^2 values above 0.67 are considered substantial, values between 0.33 and 0.67 indicate a moderate level, and values ranging from 0.19 to 0.33 suggest a weak and R^2 values below 0.19 are undesirable. Table 5 presents the structural model indicators. The model accounts for 15.6% of the variance in self-regulation and 11.8% of the variance in students' performance, as indicated by the R^2 values. These values suggest the model has a very weak explanatory power, which is accepted. The adjusted R^2 values (0.154 and 0.113, respectively) confirm the robustness of these results while adjusting for the number of predictors in the model.

Table 5.
Coefficient of Determination (R Square).

Constructs	R-square	R-square adjusted
Self-Regulation	0.156	0.154
Students' Performance	0.118	0.113

Additionally, the f^2 effect sizes were computed to assess the impact of each exogenous variable on the R^2 value of the endogenous constructs. By convention, f^2 values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively. The (f^2) effect size analysis reveals that self-regulation have a small impact on students' performance ($f^2 = 0.082$), while curriculum design has only a no effect ($f^2 = 0.009$) on students' performance. Moreover, curriculum design exerts a moderate effect on self-regulation ($f^2 = 0.185$) in Table 6.

Table 6.
Effect Sizes (f^2) Analaysis.

Students'Peformance	Effect Size	Decisions
Curriculum Design	0.009	None
Self-Regulation	0.082	Small
Sefl-Regulation	**Effect Size**	**Decisions**
Curriculum Design	0.185	Moderate

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 9: 731-741, 2025
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Furthermore, Q^2 values were derived using the blindfolding procedure to evaluate the model's predictive relevance; values greater than zero suggest that the model has sufficient predictive accuracy [23, 24]. The Q^2 values for the endogenous constructs indicate that the model has predictive relevance. Specifically, the Q^2 for students' performance is 0.081, reflecting a medium level of predictive relevance. The Q^2 for self-regulation is 0.114, 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	1,701.066	0.114
Students' Performance	5,120.000	4,705.170	0.081

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 0.079 below the recommended threshold of 0.10 it can be concluded that the model used in this study has a good fit [23, 24]. 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	0.079	0.079
d_ULS	3.257	3.257
d_G	10.698	10.698
Chi-Square	9094.518	9094.518
NFI	0.504	0.504

Edelweiss Applied Science and Technology
ISSN: 2576-8484
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DOI: 10.55214/2576-8484.v9i9.9952

4.3. Hypothesis Testing

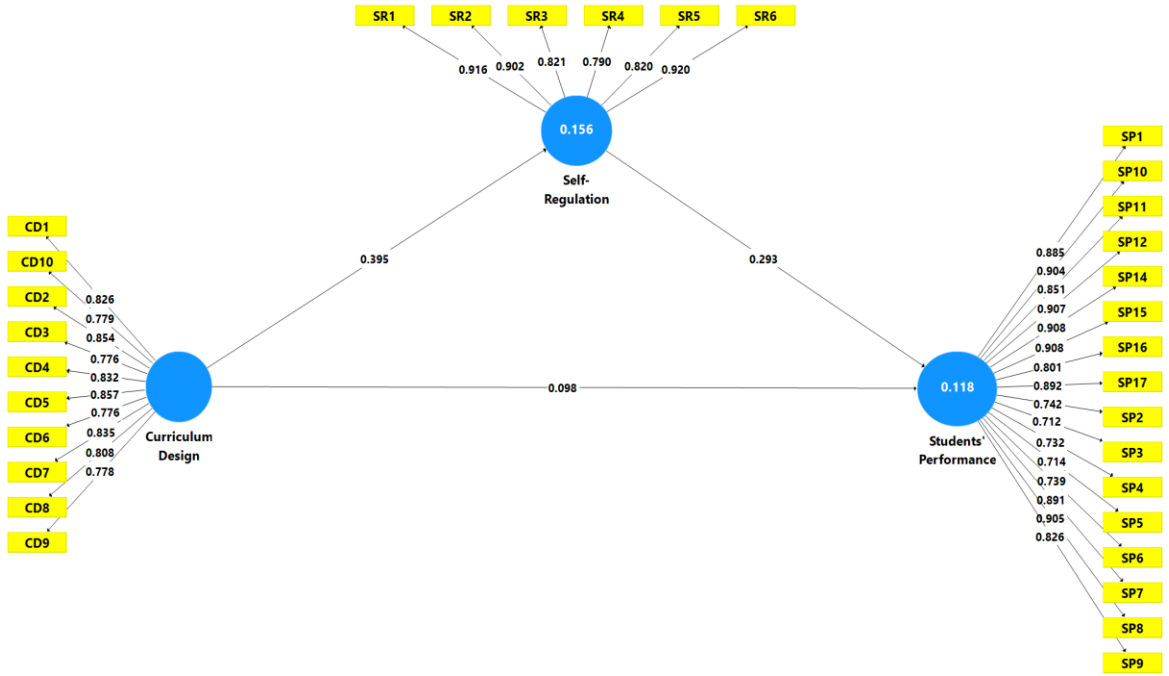

Figure 2.
Path Model Significant.

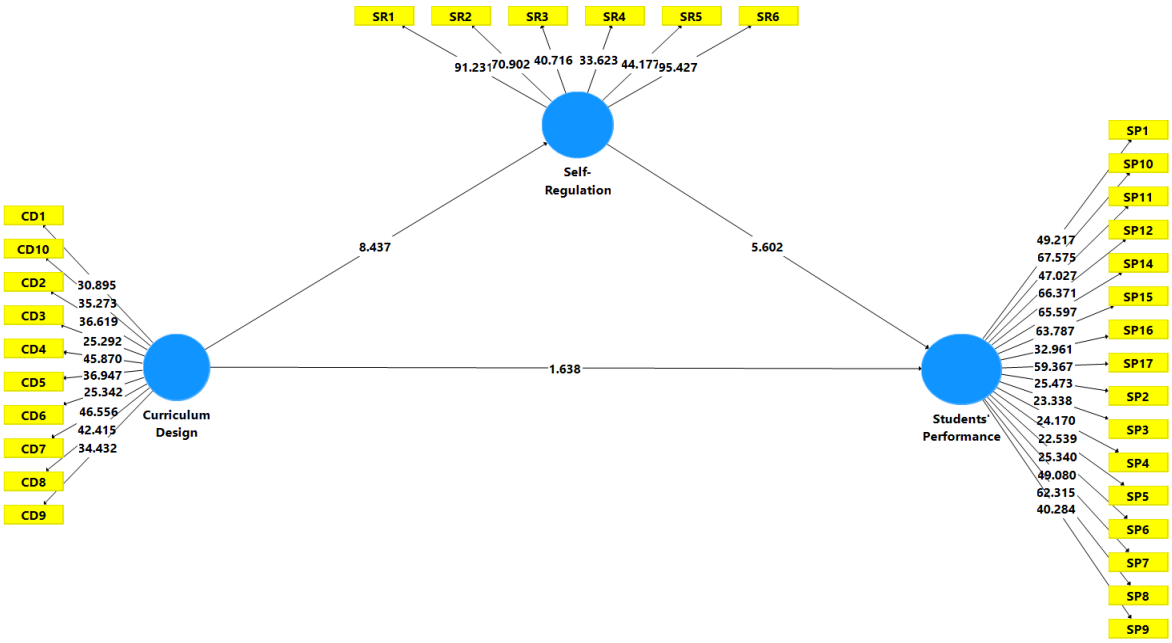

Figure 3.
Path Model Results of Mediation.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 9: 731-741, 2025
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This study explored the relationships among curriculum design, self-regulation, and students' academic performance in Cambodian higher education. Employing Partial Least Squares Structural Equation Modeling (PLS-SEM), the findings confirmed all four hypotheses (*H1–H4*), demonstrating that curriculum design exerts both direct and indirect effects on students' academic outcomes.

The findings reveal a positive but statistically non-significant effect of curriculum design on students' academic performance ($\beta = 0.099$, $t = 1.655$, $p = 0.099$), indicating that *H1* is not supported. This suggests that curriculum design alone may not directly enhance students' performance in Cambodian higher education. This result contrasts with studies by Van Zyl, et al. [28] and Tashi [29] who reported significant positive impacts of curriculum design on student engagement and educational outcomes. The inconsistency may stem from contextual differences or the mediating influence of other variables, such as self-regulation, which warrants further exploration.

The findings confirm that curriculum design has a positively significant influence on self-regulation among higher education students in Cambodia ($\beta = 0.405$, $t = 8.580$, $p = 0.000$), thus supporting *H2*. It aligns with the work of Brosens [30] who emphasized that thoughtfully designed, project-based curricula can effectively promote self-regulating soft skills, particularly in collaborative and applied learning contexts. These findings suggest that curriculum elements—such as autonomy, clarity of learning outcomes, and active learning strategies—serve as powerful enablers of self-regulated learning behaviors in the Cambodian higher education setting.

The results confirm that self-regulation has a statistically significant influence on students' performance of higher education in Cambodia ($\beta = 0.296$, $t = 5.420$, $p = 0.000$), thus supporting *H3*. This finding aligns with Elesio [31] who emphasized that self-regulated learning strategies significantly enhance academic outcomes among college students. The result underscores the crucial role of self-regulatory behaviors—such as goal setting, time management, and self-monitoring—in fostering academic success.

The findings indicate that self-regulation significantly mediates the relationship between curriculum design and students' academic performance ($\beta = 0.120$, $t = 4.370$, $p = 0.000$), thereby supporting *H4*. This result highlights that well-designed curriculum enhances students' performance indirectly by fostering students' self-regulatory capabilities. It is consistent with Park and Kim [32] who emphasized the pivotal role of self-regulation in linking instructional design to improved engagement and academic outcomes in higher education.

Table 9.
Direct and Indirect Effect Hypotheses Testing.

Hypothesis	Coef.	Se	T value	P values	Decision
Curriculum Design -> Students' Performance	0.099	0.059	1.655	0.099	Not Supported
Curriculum Design -> Self-Regulation	0.405	0.046	8.580	0.000	Supported
Self-Regulation -> Students' Performance	0.296	0.054	5.420	0.000	Supported
Curriculum Design -> Self-Regulation -> Students' Performance	0.120	0.027	4.370	0.000	Supported

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

5. Conclusion

This study explored the relationship between curriculum design and student academic performance in Cambodian higher education, with self-regulation as a mediating factor. The measurement model demonstrated strong reliability and validity (CA > 0.70, CR > 0.90, AVE > 0.60), and discriminant validity was established via the Fornell–Larcker criterion and HTMT values below 0.90. The structural model showed moderate explanatory power for student learning outcomes (R^2 values), and Q^2 values above zero confirmed predictive relevance. Effect size analysis indicated that self-regulation had a small impact on student performance ($f^2 = 0.082$), curriculum design had no direct effect on performance ($f^2 = 0.009$), but a moderate effect on self-regulation ($f^2 = 0.185$). The Goodness-of-Fit (GoF) score further supported model adequacy. In hypothesis testing, *H1* was not supported, as curriculum design did not

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 9, No. 9: 731-741, 2025
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significantly affect performance directly (β = 0.099, t = 1.655, p = 0.099). *H2* was supported, showing a strong effect of curriculum design on self-regulation (β = 0.405, t = 8.580, p = 0.000), and *H3* confirmed that self-regulation significantly enhanced performance (β = 0.296, t = 5.420, p = 0.000). *H4* validated the mediating role of self-regulation between curriculum design and academic performance (β = 0.120, t = 4.370, p = 0.000). These findings suggest that while curriculum design does not directly influence academic outcomes, it enhances them indirectly by promoting self-regulation—highlighting the need for learner-centered curricula that foster autonomy and strategic learning.

This study faces several limitations, including its cross-sectional design, which restricts causal conclusions, and the use of self-reported data, which may introduce bias. The focus on Cambodian higher education limits generalizability, and other potential mediators such as motivation, engagement, or emotional regulation were not explored. Future research should address these gaps through longitudinal methods, broader samples, and expanded models.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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