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The mediating role of self-efficacy in the relationship between ICT competency and learning outcomes in Cambodian public universities

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Abstract: This study examines the mediating role of self-efficacy in the relationship between Information and Communication Technology (ICT) competency and learning outcomes among students in Cambodian public higher education institutions. Grounded in Bandura's social cognitive theory, the research investigates how students' digital skills and confidence jointly influence academic success. A quantitative approach was adopted, utilizing Partial Least Squares Structural Equation Modeling (PLS-SEM). From 384 distributed questionnaires, 326 valid responses were collected, resulting in an response rate of 84.9%. The measurement model demonstrated strong reliability and validity, with Cronbach's alpha exceeding 0.90 and Average Variance Extracted (AVE) above 0.70. Discriminant validity was confirmed through the Fornell–Larcker criterion and the Heterotrait-Monotrait (HTMT) ratio. Structural model results indicate that ICT competency positively influences both learning outcomes ($\beta = 0.300$, $p < 0.001$) and self-efficacy ($\beta = 0.270$, $p < 0.001$). Additionally, self-efficacy showed a significant effect on learning outcomes ($\beta = 0.341$, $p < 0.001$) and mediated the relationship between ICT competency and learning outcomes ($\beta = 0.092$, $p < 0.001$). The model explained 25.8% of the variance in learning outcomes ($R^2 = 0.258$) and 7.4% in self-efficacy ($R^2 = 0.074$). These findings highlight self-efficacy as a crucial mechanism through which digital competencies enhance student performance, emphasizing the importance of integrated strategies that strengthen both ICT skills and learner confidence.

Keywords: *Cambodia, Higher education, ICT competency, Learning outcomes, Self-efficacy.*

1. Introduction

In the context of rapidly evolving digital technologies, Information and Communication Technology (ICT) has become a transformative force in global education, particularly within the higher education sector. With the increasing digitization of learning environments, ICT has reshaped teaching methodologies, course delivery, and institutional operations. This technological shift has been particularly impactful in emerging education systems such as Cambodia, where the government and universities have actively embraced ICT to enhance educational access, equity and quality. However, despite considerable investments and global trends in ICT adoption, the nuanced mechanisms through which technology influences academic outcomes remain underexplored, especially the psychological constructs that may mediate its effectiveness. One such construct is self-efficacy, which reflects students' belief in their ability to manage and succeed in academic tasks. While a growing body of literature highlights the link between ICT use and improved learning outcomes, there is still limited empirical investigation into how self-efficacy mediates this relationship. In the Cambodian context, this gap is particularly evident, with few studies replicating international research on the intersection of ICT, self-efficacy, and academic performance. This study addresses this gap by examining the complex interplay between ICT competency, self-efficacy, and learning outcomes in Cambodian higher education. It explores how self-efficacy influences students' engagement with technology and their academic success,

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while also assessing the broader educational landscape, challenges, and opportunities associated with ICT integration. The study outlines clear research questions, objectives and definitions, while emphasizing its significance for educators, institutions, policymakers, and researchers both within Cambodia and globally.

The rapid evolution of ICT has redefined educational landscapes globally, offering dynamic tools that reshape pedagogical practices and enhance access to learning. In the context of higher education, particularly within emerging systems such as Cambodia's ICT competency is the ability to effectively utilize digital tools for academic tasks has emerged as a critical determinant of learning success. However, the effectiveness of ICT integration depends not only on access or infrastructure but also on learners' psychological readiness, particularly their self-efficacy. Self-efficacy, rooted in Bandura's social cognitive theory, refers to students' belief in their capacity to execute academic tasks using available resources, including ICT tools. Students with high levels of ICT self-efficacy are more likely to embrace digital learning platforms, engage deeply with course content, and apply strategic learning behaviors, which collectively enhance learning outcomes. Conversely, students with low self-efficacy may underutilize available technologies, resulting in diminished academic performance. Thus, self-efficacy functions as a mediating mechanism that shapes how students interact with ICT and influences the extent to which ICT competencies translate into measurable academic success [1, 2]. In the Cambodian higher education context, disparities in digital literacy and infrastructural constraints further highlight the need to understand the interplay between ICT competency, self-efficacy, and learning outcomes. This study addresses a critical gap in the literature by investigating how self-efficacy mediates the relationship between ICT competency and learning outcomes among Cambodian university students. This study is structured around the following guiding research questions:

RQ1: To what extent does ICT competency influence learning outcomes in Cambodian public higher education?

RQ2: How does ICT competency affect students' self-efficacy in Cambodian public higher education?

RQ3: What is the relationship between self-efficacy and learning outcomes in Cambodian public higher education?

RQ4: Does self-efficacy mediate the relationship between ICT competency and learning outcomes in Cambodian public higher education?

The primary objective of this research is to investigate the mediating role of self-efficacy in the relationship between ICT competency and learning outcomes among students in Cambodian higher education institutions. Furthermore, the study aims to evaluate the current state of ICT adoption in Cambodian universities, identify barriers to effective technology use, and provide actionable insights for educators, policymakers, and institutional leaders. Ultimately, this research aspires to contribute to a deeper understanding of how to optimize technology-enhanced learning environments through targeted strategies that support both digital skill development and learner confidence, thereby improving educational quality and student success in Cambodia's rapidly evolving academic landscape.

2. Literature Review

Information and Communication Technology (ICT) has become a powerful catalyst in modern education, providing innovative approaches to improve teaching practices, learning experiences, and the overall effectiveness of educational institutions. ICT competency plays a pivotal role in shaping students' academic engagement and the overall quality of education. Beyond basic access, ICT competency encompasses the skills required to navigate, evaluate, and apply digital information in meaningful academic contexts. As Iwadi, et al. [3] and Adtani, et al. [4] explain, ICT spans a broad spectrum of technologies used for acquiring, storing, processing, and communicating information, including hardware, software, networking infrastructure, and digital content. Mastery of these tools equips learners to participate more fully in interactive and autonomous learning environments. Student engagement, characterized by cognitive, emotional, and behavioral participation in academic activities, is deeply influenced by ICT competency. When students possess the skills to use digital resources

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effectively, they are more likely to engage actively in learning processes such as collaborating, problem-solving, and managing tasks with greater independence. This engagement, in turn, contributes significantly to the quality of education, fostering deeper understanding, skill development, and academic persistence. Akintayo, et al. [5] emphasize that the integration of ICT into educational practice not only enhances learning experiences but also boosts institutional reputation and effectiveness. Consequently, building students' ICT competency is essential for cultivating engaged learners and improving educational quality. In the context of rapidly evolving technological demands, equipping students with ICT skills is not merely advantageous but fundamental to achieving equitable and high-impact learning outcomes in higher education.

Self-efficacy, a core element of social cognitive theory, refers to an individual's belief in their capability to accomplish tasks and attain desired outcomes. Within the realm of higher education, academic self-efficacy is a critical determinant of students' motivation, learning behaviors, and academic achievement. Learners with strong self-efficacy exhibit confidence in planning, managing, and completing academic tasks, even when confronted with challenges [1]. They are more resilient, actively engage with course content, and seek out support and resources to improve their learning experience. In contrast, students with low self-efficacy often display uncertainty, exert less effort, and show weaker academic commitment, which can hinder performance and persistence. Schunk and DiBenedetto [6] emphasize that academic self-efficacy significantly predicts learning outcomes by shaping students' goal-setting behaviors, effort management, and use of effective learning strategies. These beliefs influence how students interpret and respond to academic demands, guiding their motivation and approach to learning challenges. Similarly, Oriol-Granado, et al. [7] highlight that self-efficacy reflects not only confidence in managing academic tasks but also the capacity to recognize and adapt to both opportunities and obstacles in the learning environment. High self-efficacy encourages students to take on complex academic tasks, persevere through setbacks, and adopt strategic learning approaches. As a result, fostering academic self-efficacy is essential for promoting student success, particularly in educational contexts characterized by rapid technological and pedagogical change. Enhancing students' belief in their own abilities contributes to a more inclusive, engaged, and high-achieving academic community.

Learning outcomes are essential elements in the development and assessment of educational programs, offering precise descriptions of the knowledge, skills, and values students are expected to acquire by the end of a learning experience. Far beyond general educational goals, learning outcomes provide specific, measurable benchmarks that inform both instructional planning and evaluation strategies. As noted by Yusop, et al. [8] learning outcomes span cognitive, affective, and psychomotor domains, reflecting not only what students should understand but also what they should be able to do and the attitudes they are expected to develop. These outcomes are typically articulated in clear, observable terms aligned with curricular objectives, enabling students and educators to share a common framework for teaching and learning Peng and Ali [9]. Iwano and Tsuda [10] describe learning outcomes as navigational tools for education, comparable to a system that guides curriculum design and student advancement. By explicitly stating the intended results of instruction, learning outcomes assist educators in selecting relevant content, pedagogical approaches, and assessment techniques. For students, clearly defined outcomes provide a transparent learning path and encourage greater autonomy in their educational journey. In curriculum planning, such outcomes promote coherence across courses and support institutional efforts to evaluate program quality, align instruction with industry needs, and ensure meaningful learning experiences [11]. Therefore, learning outcomes are not mere administrative requirements, but they are vital indicators of educational effectiveness, student progress, and institutional integrity. They guide teaching, enhance learner engagement, and serve as measurable indicators of success in higher education [12].

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2.1. ICT Competency and Learning Outcomes

The integration of ICT in education has become an essential pillar for improving instructional practices and enhancing student learning outcomes in the 21st century. Central to this transformation is the ICT competency of educators, which not only influences their ability to deliver content effectively but also plays a critical role in shaping student engagement and academic performance. Teachers with high ICT proficiency are more likely to integrate digital tools creatively and confidently into classroom practices, thereby fostering interactive and learner-centered environments. ICT competence encompasses not just technical skills but also pedagogical understanding of how technology can be aligned with curriculum goals to support differentiated instruction and assessment. However, disparities in ICT skill levels are linked to age, gender, and access to professional training that can hinder the equitable adoption of these tools. The successful implementation of ICT in classrooms is contingent upon a combination of factors, including teacher self-efficacy, institutional support, and ongoing professional development opportunities. Training programs that build both technological literacy and pedagogical integration capacity are vital for promoting sustained ICT use in education. Without such support, even well-intentioned digital initiatives may fail to translate into meaningful learning gains. Furthermore, ICT integration has been shown to bridge digital divides and stimulate student motivation by introducing innovative methods that transcend traditional instruction. Ultimately, teacher ICT competence is a decisive factor in ensuring that digital tools serve as enablers of quality education rather than as mere supplements. As such, investing in educator training and support remains a cornerstone for improving learning outcomes in technology-enhanced educational contexts [13, 14]. Based on the theoretical and empirical foundations discussed, it is hypothesized that:

H_1: ICT competency has a positively significant influence on Cambodian Public Higher Education Learning Outcomes.

2.2. ICT Competency and Self-Efficacy

ICT competency, encompassing the knowledge, skills, and attitudes required to effectively utilize digital tools, has become a foundational requirement for academic and professional success in the 21st century. Closely linked to this is self-efficacy, the belief in one's capacity to execute tasks and manage challenges which plays a pivotal role in determining how individuals approach technology use. Research demonstrates a strong, bidirectional relationship between ICT competency and self-efficacy: individuals with higher digital proficiency tend to exhibit greater confidence in using technology, while those with elevated self-efficacy are more likely to engage in continuous learning and enhance their ICT skills [15]. However, disparities in ICT access, training, and contextual support can influence both perceived competence and actual performance, particularly in under-resourced educational environments. For instance, formal training and positive prior experiences with digital tools contribute to higher self-efficacy, while limited exposure or negative interactions with technology can suppress confidence regardless of competency levels [16]. Moreover, the specific context and nature of ICT tasks are ranging from basic applications to complex problem-solving that can affect self-perception and learning outcomes. As such, interventions aimed at improving ICT-related educational outcomes should be multifaceted, emphasizing both technical skill development and psychological readiness. In higher education settings, especially in developing countries, cultivating ICT competency alongside self-efficacy can empower students to navigate digital learning environments with confidence, autonomy, and effectiveness, ultimately leading to improved academic achievement and lifelong learning readiness. Drawing from the theoretical insights and empirical evidence presented, the following hypotheses are proposed:

H_2: ICT competency has a positively significant influence on self-efficacy in Cambodia Public Higher Education.

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2.3. Self-Efficacy and Learning Outcomes

Self-efficacy is a key determinant of students' academic engagement and success within higher education environments. Drawing from Bandura's social cognitive theory, self-efficacy refers to an individual's confidence in their ability to complete tasks and reach desired goals [17]. In academic settings, students with strong self-efficacy are more inclined to face learning challenges with determination, persistence, and effective strategies, which in turn enhances their motivation and academic performance. These students often set high expectations for themselves, demonstrate perseverance in the face of obstacles, and utilize efficient learning techniques that foster deeper cognitive involvement and success. Research has consistently shown that academic self-efficacy is a strong predictor of students' capacity to manage their own learning, use time effectively, and maintain a constructive academic mindset [18]. Recent findings also highlight self-efficacy's mediating effect in the link between technology use and academic achievement. For example, Ibrahim and Aldawsari [14] found that self-efficacy significantly amplifies the positive impact of ICT use on learning outcomes. Their research indicated that students who engage with digital tools in a focused and intentional way tend to perform better academically when they believe in their ability to use those tools proficiently. As a result, ICT self-efficacy—students' self-perceived competence in using technology—stands out as a key factor influencing both how frequently and how effectively technology is utilized in educational settings. Building on the theoretical framework and supporting empirical findings, the study puts forward the following hypotheses:

H_3: Self-efficacy has a positively significant influence on Cambodian Public Higher Education Learning Outcomes.

2.4. Self-Efficacy, ICT Competency and Learning Outcome

The integration of ICT in higher education has emerged as a catalyst for promoting student self-efficacy and enhancing learning outcomes. ICT competency, defined as the ability to effectively utilize digital tools and platforms, is increasingly recognized as a critical skill in academic settings. When students possess the confidence to navigate ICT tools independently, they are more likely to engage in self-regulated learning likes setting academic goals, monitoring progress, and adjusting strategies thereby fostering greater autonomy and academic achievement. Research has established that ICT self-efficacy, or students' belief in their capacity to perform ICT-related academic tasks, is positively correlated with perceived academic success and skill development [19]. ICT-supported environments, such as online learning platforms, digital collaboration tools, and multimedia resources, provide students with continuous opportunities to practice self-directed learning behaviors, which reinforce their belief in their academic capabilities. This cyclical relationship suggests that higher ICT competency enhances self-efficacy, which in turn leads to improved engagement and learning performance [14]. However, disparities in to technology, digital literacy levels, and instructional support continue to mediate this relationship, especially in under-resourced educational settings. Moreover, students' motivation, prior experiences, and socio-economic factors also influence their ICT self-efficacy and, consequently, learning outcomes. Therefore, cultivating ICT competency alongside self-efficacy is essential not only for academic success but also for preparing students for lifelong learning in a digital society. This study builds on this premise, examining the intertwined roles of ICT competency and self-efficacy in shaping learning outcomes in the context of Cambodian higher education. Based on the established theoretical foundation and corroborating empirical evidence, this study proposes the following hypotheses:

H_4: Self-efficacy has a positively significant mediating influence on the relationship between ICT competency and Cambodian Public Higher Education Learning Outcomes.

2.5. Hypotheses and Theoretical Framework

H_1: ICT competency has a positively significant influence on Cambodian Public Higher Education Learning Outcomes.

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H_2: ICT competency has a positively significant influence on self-efficacy in Cambodia Public Higher Education.

H_3: Self-efficacy has a positively significant influence on Cambodian Public Higher Education Learning Outcomes.

H_4: Self-efficacy has a positively significant mediating influence on the relationship between ICT competency and Cambodian Public Higher Education Learning Outcomes.

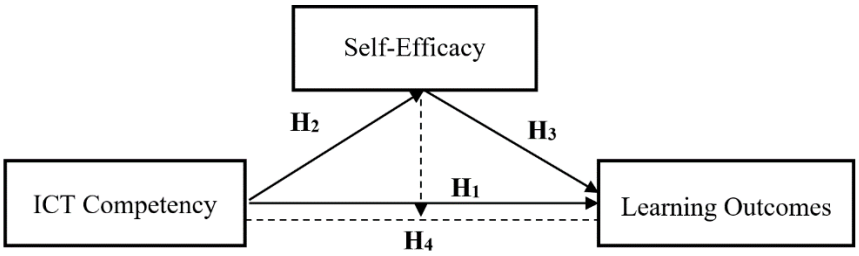

Figure 1.
Theoretical Framework.

3. Methodology

The quantitative research method is a scientific approach to conducting a study and therefore will contain either experiments or other systematic methods to highlight control samples and calculate measurements of individual actions [20]. Moreover, the population would cover all the elements that make up the study analysis on which the researcher wishes to make specific conclusions [21]. Consequently, the present research focuses on students from three selected public universities in Cambodia. These public universities were chosen for this study for several key reasons. Furthermore, Krejcie and Morgan [22] observed that the growing need for research has spurred efforts to identify an effective approach for determining the sample size necessary to accurately represent the population being studied.

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 the majority of the constructs ranged from 0.713 to 0.900, thereby exceeding the commonly accepted threshold of 0.70 [23]. Following the pilot validation, hard copies of the finalized questionnaires were distributed to students at selected 3 public universities in Cambodia to ensure efficient and effective data collection. In total, 384 hard-copy questionnaires were distributed to the students across selected public higher education institutions in Cambodia. This effort yielded 348 returned surveys, representing a response rate of approximately 90.6%. Upon screening the responses, 58 questionnaires were excluded due to substantial incomplete data. Consequently, 326 fully completed and valid questionnaires were retained for subsequent analysis. Thus, the overall response rate was 84.9%, which is considered acceptable for quantitative analysis.

The primary constructs in the study were assessed using a five-point Likert scale, with response options ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire was divided into four sections. Items addressing ICT Competency were designed to reflect the technological context, drawing on established frameworks. Self-efficacy measures were adapted from previously validated scales, while learning outcomes was assessed using multiple dimensions based on prior educational research.

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 [24]. In this study, SmartPLS 3.0 was employed to estimate both

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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.

Table 1.
The demographic characteristics of the respondents.

Factors	Classification	Repetition	Proportion
Gender	Male	155	47.5
	Female	171	52.5
Age	<20yrs	109	33.4
	20-22yrs	121	37.1
	23-25yrs	86	26.4
	25yrs >	10	3.1
Institutions	National University of Management	96	29.4
	Royal University of Phnom Penh	197	60.4
	National University of Battambang	33	10.1
N		326	

Table 2.
Construct Reliability and Validity.

Construct	Items	Loadings	Cronbach Alpha	Composite Reliability	Average Variance Extracted
ICT Accessibilities	IC1	0.926	0.980	0.983	0.815
	IC13	0.955			
	IC14	0.951			
	IC15	0.950			
	IC16	0.950			
	IC17	0.726			
	IC18	0.717			
	IC19	0.940			
	IC2	0.906			
	IC3	0.919			
	IC4	0.943			
	IC5	0.939			
	IC8	0.869			
Learning Outcomes	LO1	0.940	0.946	0.957	0.760
	LO2	0.910			
	LO3	0.805			
	LO4	0.775			
	LO5	0.809			
	LO6	0.931			
	LO7	0.916			
Self-Efficacy	SE1	0.791	0.959	0.965	0.735
	SE10	0.738			
	SE2	0.890			
	SE3	0.918			
	SE4	0.927			
	SE5	0.901			
	SE6	0.829			
	SE7	0.927			
	SE8	0.831			
	SE9	0.796			

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4. Result

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 [24]. All constructs demonstrated strong internal consistency (α and CR > 0.90) and convergent validity (AVE > 0.70). Items with loadings between 0.70 and 0.90 were kept in the model.

Table 3 illustrates that discriminant validity was established through the Fornell–Larcker criterion, confirming that each construct is empirically unique. The square roots of the AVE values for ICT Competency (0.903), Self-Efficacy (0.857), and Learning Outcomes (0.872) all exceeded their respective correlations with other constructs, meeting the threshold recommended by Fornell and Larcker [25]. These findings validate the discriminant validity and further strengthen the reliability of the measurement model [24].

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

Constructs	IC	LO	SE
ICT Competency (IC)	0.903		
Learning Outcomes (LO)	0.390	0.872	
Self-Efficacy (SE)	0.272	0.420	0.857

Table 4, discriminant validity was further supported using the Heterotrait-Monotrait Ratio (HTMT), with all values below the 0.90 threshold [24]. Specifically, the values for IC–LO (0.403), IC–SE (0.278), and SE–LO (0.439) demonstrate a clear separation between the constructs, thereby confirming robust discriminant validity within the measurement model.

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

Constructs	IC	LO	SE
ICT Competency (IC)			
Learning Outcomes (LO)	0.403		
Self-Efficacy (SE)	0.278	0.439	

4.2. 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 [26]. The coefficient of determination (R^2) for Learning Outcomes is 0.258, indicating that approximately 25.8% of the variance in Learning Outcomes can be explained by the predictors included in the model. The adjusted R^2 value of 0.254 reflects a minimal decrease from the original R^2, indicating that the model's explanatory power remains stable after controlling for the number of predictors. This suggests that the model is not overfitted and retains its ability to meaningfully explain variance in learning outcomes, even when adjusted for complexity. This level of explained variance, while moderate, suggests that other unmeasured variables may also contribute substantially to Learning Outcomes. In contrast, the R^2 value for Self-Efficacy is 0.074, with an adjusted R^2 of 0.071. These values indicate that only 7.4% of the variance in Self-Efficacy is accounted for by the model, reflecting a weak explanatory capacity. The small difference between R^2 and adjusted R^2 also suggests that overfitting is unlikely; however, the low magnitude highlights the limited predictive power of the included variables in explaining Self-Efficacy. This may point to the need for incorporating additional or alternative predictors to more comprehensively model this construct in Table 5.

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Table 5.
Coefficient of Determination (R Square).

Constructs	R-square	R-square adjusted
Learning Outcomes	0.258	0.254
Self-Efficacy	0.074	0.071

Additionally, the f^2 effect sizes were computed to assess how much each exogenous variable contributed to the R^2 of the endogenous constructs. According to Cohen [27] effect sizes of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively. Both ICT Competency ($f^2 = 0.110$) and Self-Efficacy ($f^2 = 0.114$) exhibit small but comparable contributions toward explaining Learning Outcomes. Similarly, ICT Accessibility shows a small effect ($f^2 = 0.080$) in predicting Self-Efficacy, suggesting a limited yet statistically meaningful influence in Table 6.

Table 6.
Effect Sizes (f^2) Analaysis

Learning Outcomes	Effect Size	Decisions
ICT Competency	0.110	Small
Self-Efficacy	0.114	Small
Sefl-Efficacy	**Effect Size**	**Decisions**
ICT Assessibility	0.080	Small

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 [28]. The Q^2 value for Learning Outcomes was 0.181, calculated from a sum of squares of errors (SSE) of 2,282.000 and a sum of squares of observations (SSO) of 1,867.965. This value exceeds the minimum threshold of 0.00 and suggests that the model exhibits medium predictive relevance for the construct [24].The Q^2 value for Learning Outcomes is 0.191, indicating a moderate level of predictive relevance. This suggests that the model has a meaningful ability to predict variance in Learning Outcomes based on the exogenous constructs included. In contrast, the Q^2 value for Self-Efficacy is 0.053, which falls into the small predictive relevance range. While the model exhibits some predictive capability for Self-Efficacy, the magnitude is limited, suggesting that additional predictors may be necessary to improve its predictive performance for this construct in *Table 7*.

Table 7.
Construct Cross Validated Redundancy (Q2)

Constructs	SSE	SSO	1-SSE/SSO
Learning Outcomes	2,282.000	1,845.242	0.191
Self-Efficacy	3,260.000	3,087.830	0.053

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

Therefore, the SRMR values for both the saturated model and the estimated model are 0.056, which is below the recommended threshold of 0.10. This indicates that the model employed in this study demonstrates a good fit [24]. A summary of the structural model indicators is presented in Table 8.

Table 8.
Goodness of Fit of The Model.

Item	Saturated Model	Estimated Model
SRMR	0.056	0.056
d_ULS	1.462	1.462
d_G	8.334	8.334
Chi-Square	7,681.476	7,681.476
NFI	0.612	0.612

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4.3. Hypothesis Testing

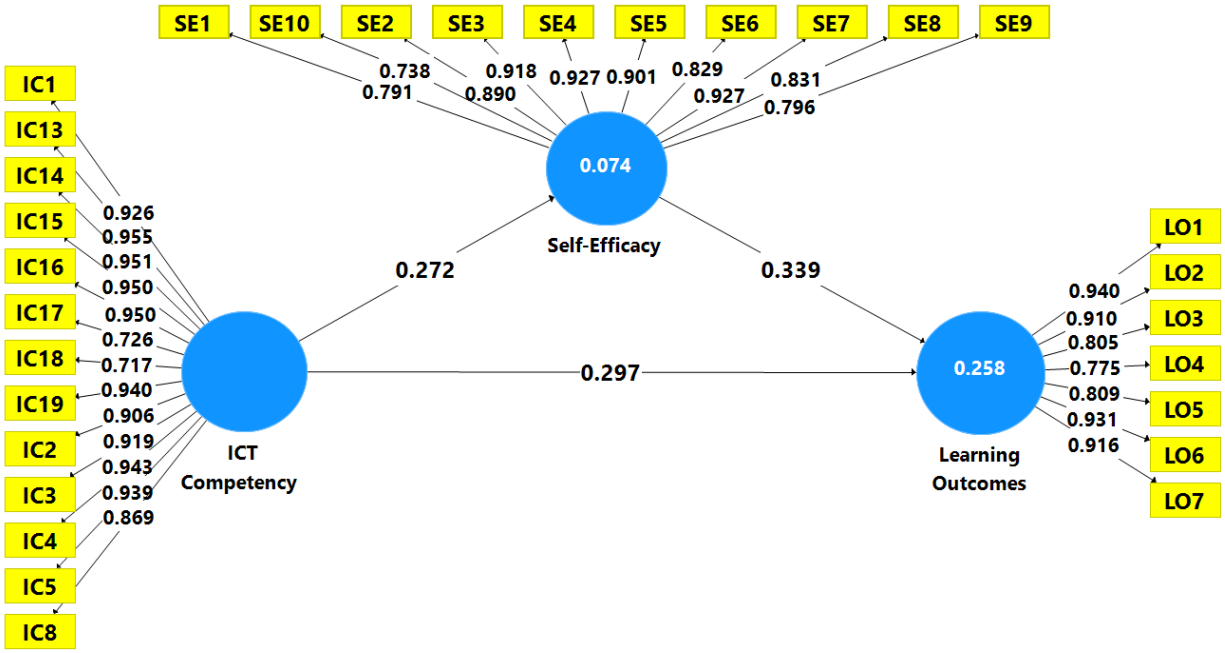

Figure 2.
Path Model Significant.

Table 9 shows H1: ICT competency has a positively significant influence on Cambodian Public Higher Education Learning Outcomes. The standardized path coefficient (β = 0.300, p = 0.000) indicates a positive and statistically significant effect of ICT competency on Learning Outcomes. The t-value of 6.412 exceeds the 1.96 threshold, confirming statistical significance and supporting H1. This finding suggests that improved ICT competency among students is associated with enhanced learning outcomes in the Cambodian public higher education context.

$H_{2:}$ ICT competency has a positively significant influence on self-efficacy in Cambodian Public Higher Education. With a path coefficient of β = 0.270 and a highly significant p-value (p = 0.000), ICT competency also exerts a significant positive influence on self-efficacy. The t-value of 5.624 further supports the robustness of this relationship. Therefore, H2 is supported, implying that students with higher ICT skills are more likely to feel confident in their ability to perform academic tasks effectively.

$H_{3:}$ Self-efficacy has a positively significant influence on Cambodian Public Higher Education Learning Outcomes. The strongest effect is observed here, with a path coefficient of β = 0.341 and a t-value of 6.815, which is statistically significant at the 0.000 level. This indicates a strong positive relationship between self-efficacy and learning outcomes. Thus, H3 is supported, reinforcing the notion that self-efficacy is a critical mediator and determinant of academic success.

Table 9.
Direct Effect Hypotheses Testing.

Hypothesis	Coef.	Se	T value	P values	Decision
ICT Competency -> Learning Outcomes	0.300	0.046	6.412	0.000	*Supported*
ICT Competency -> Self-Efficacy	0.270	0.048	5.624	0.000	*Supported*
Self-Efficacy -> Learning Outcomes	0.341	0.050	6.815	0.000	*Supported*

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

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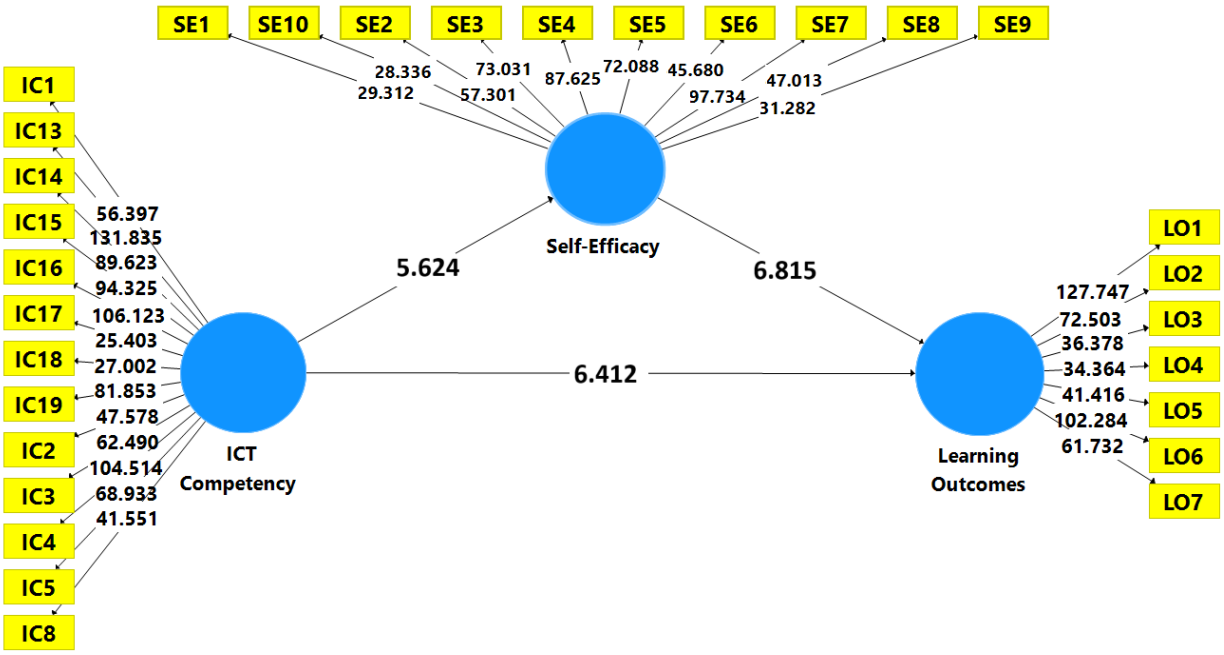

Figure 3.
Path Model Results of Mediation.

Table 10 shows Hypothesis 4 posited that self-efficacy mediates the relationship between ICT competency and Learning Outcomes within the context of Cambodian public higher education. The mediation analysis reveals a statistically significant indirect effect of ICT competency on Learning Outcomes through self-efficacy (β = 0.092, p = 0.000). The t-value of 4.376, well above the critical threshold of 1.96, confirms the robustness of this mediating effect. This finding indicates that ICT competency positively influences learning outcomes not only directly but also indirectly by enhancing students' self-efficacy. In other words, students with higher ICT skills tend to develop stronger beliefs in their academic capabilities (self-efficacy), which in turn contributes to improved learning outcomes.

Table 10.
Indirect Effect Hypotheses Testing.

Hypothesis	Coef.	Se	T value	P values	Decision
ICT Competency -> Self-Efficacy -> Learning Outcomes	0.092	0.021	4.376	0.000	Supported

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

5. Discussion

This study examined the relationships between teaching methods, self-regulation, and students' academic performance in Cambodian higher education. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), all four hypotheses (H1–H4) were statistically supported, indicating both direct and indirect influences of teaching practices on academic outcomes.

The findings support H1, indicating that ICT competency has a positively significant influence on learning outcomes in Cambodian public higher education (β = 0.300, p = 0.000; t = 6.412). This statistically significant result confirms that students with higher ICT competency tend to achieve better academic outcomes. This result aligns with prior research. For instance, Patwardhan, et al. [29] demonstrated that students' digital competence positively impacts perceived learning, particularly when mediated by learner agility, suggesting that digital skills enable learners to adapt and perform better in dynamic academic environments. Similarly, Almerich, et al. [30] found that ICT competencies are significantly related to higher-order thinking and teamwork skills, both of which are essential

components of successful learning in higher education. Furthermore, Ashraf, et al. [31] emphasized the role of curriculum content and teaching strategies in fostering ICT skills, which in turn contribute to improved student engagement and learning outcomes in blended learning environments. These studies reinforce the importance of integrating ICT skill development into the higher education curriculum to enhance academic performance.

The results confirm H2, indicating that ICT competency has a positively significant influence on self-efficacy among students in Cambodian public higher education ($\beta = 0.270$, $p = 0.000$; $t = 5.624$). This statistically significant relationship suggests that students with higher levels of digital proficiency tend to exhibit greater confidence in their academic capabilities. This finding is supported by Putri, et al. [32] who observed that ICT competence contributes significantly to learners' self-efficacy in the context of English as a Foreign Language (EFL) learning. Their study highlighted that digital skills enhance students' autonomy and belief in managing their learning processes, which is transferable to broader academic domains. Similarly, Hori and Fujii [33] founded that the use of ICT for learning purposes positively influences both self-efficacy and persistence. Their findings provide robust international evidence that digital engagement fosters students' belief in their academic potential.

The result of H3: Self-efficacy has a positively significant influence on Cambodian Public Higher Education Learning Outcomes. The strongest effect is observed here, with a path coefficient of $\beta = 0.341$ and a t-value of 6.815, which is statistically significant at the 0.000 level. This reinforces the role of self-efficacy as a key psychological predictor of academic success. Özer and Akçayoğlu [34] found that higher self-efficacy contributes to better academic performance by enhancing learners' self-regulation and reducing anxiety. Meng and Zhang [18] also demonstrated that academic self-efficacy improves achievement through increased engagement. Additionally, AL-Qadri, et al. [35] emphasized that self-efficacy positively influences learning outcomes, particularly when linked with academic commitment and self-assessment. Together, these findings highlight self-efficacy as essential for fostering sustained academic achievement in higher education contexts.

Supports H4, confirming that self-efficacy significantly mediates the relationship between ICT competency and learning outcomes in Cambodian public higher education ($\beta = 0.092$, $p = 0.000$; $t = 4.376$). This implies that ICT competency not only has a direct impact on learning outcomes but also exerts an indirect effect by enhancing students' self-belief in their academic abilities. This finding aligns with Feng, et al. [36] who found that students' ICT self-efficacy plays a critical mediating role between perceived teacher support and academic engagement in blended learning. Their study illustrates how digital confidence enhances students' motivation and active participation, contributing indirectly to academic success. Similarly, Panigrahi, et al. [37] demonstrated that student engagement mediates the effect of e-learning systems on perceived learning effectiveness, suggesting that internal psychological factors—such as self-efficacy—serve as important pathways through which technology impacts learning outcomes.

6. Conclusion

The model demonstrates a good fit, as indicated by the SRMR value of 0.056, well below the recommended 0.10 threshold. Reliability and validity of the constructs were confirmed through high internal consistency (Cronbach's alpha and CR > 0.90), strong convergent validity (AVE > 0.70), and established discriminant validity using both the Fornell–Larcker criterion and HTMT values (< 0.90). The structural model shows acceptable explanatory power, with R^2 values of 0.258 for Learning Outcomes and 0.074 for Self-Efficacy, indicating modest and weak explanatory capacities, respectively. Effect sizes (f^2) for ICT Competency and Self-Efficacy were small but significant (ranging from 0.08 to 0.114), suggesting meaningful though limited individual contributions. The Q^2 values (0.191 for Learning Outcomes; 0.053 for Self-Efficacy) further confirm the model's predictive relevance, particularly for Learning Outcomes.

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This study empirically examined the relationships among ICT competency, self-efficacy, and learning outcomes in the context of Cambodian public higher education. The structural model findings revealed that ICT competency significantly influences both learning outcomes (H1) and self-efficacy (H2). Additionally, self-efficacy exerts a significant positive effect on learning outcomes (H3) and mediates the relationship between ICT competency and learning outcomes (H4).

While this study provides valuable insights into the relationships among ICT competency, self-efficacy, and learning outcomes in Cambodian public higher education, several limitations should be acknowledged. First, the study was context-specific, focusing solely on public institutions in Cambodia; this limits the generalizability of the findings to private institutions or other national settings. Future studies should explore comparative analyses across different institutional types or regional contexts to validate and expand the model's applicability. Second, the study's cross-sectional design restricts the ability to establish clear causal relationships among variables. Longitudinal research is recommended to track changes in ICT competency and self-efficacy over time and their cumulative effects on academic performance. Additionally, the use of self-reported data introduces potential response biases, particularly in the measurement of self-efficacy and ICT skills. Future research may benefit from incorporating objective performance metrics or multi-source data to enhance validity. Finally, the model excluded potentially influential factors such as digital infrastructure, teaching quality, and motivation. Expanding the model to include these and other relevant constructs—such as learner engagement or institutional support—would provide a more holistic understanding of the mechanisms driving academic success in digital learning environments.

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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