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Academic Self-efficacy as a Foundational Predictor of Critical Thinking in Higher Education: Evidence from an Islamic University Context

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Abstract: This study examines the relationship between academic self-efficacy and critical thinking among undergraduate students at IAIN Kerinci, Indonesia. A quantitative cross-sectional correlational design was employed. The sample comprised 160 undergraduate students selected through proportionate stratified random sampling across seven study programs. Data were collected using a validated academic self-efficacy questionnaire based on social cognitive theory and an eight-item higher-order thinking essay test assessing four dimensions of critical thinking. Data were analyzed using covariance-based structural equation modeling (CB-SEM) with maximum likelihood estimation in IBM SPSS Amos. The measurement model demonstrated satisfactory construct reliability and convergent validity, with composite reliability values exceeding 0.80 and average variance extracted values above 0.50. The structural model showed acceptable fit ($\chi^2/df = 1.87$, CFI = 0.94, TLI = 0.93, RMSEA = 0.067, SRMR = 0.051). Academic self-efficacy was positively and significantly associated with critical thinking ($\beta = 0.34$, SE = 0.086, CR = 3.98, $p < 0.001$), explaining approximately 12% of the variance in critical thinking ($R^2 = 0.12$). Gender-stratified

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analysis revealed positive and statistically significant associations for both male and female students, while the comparison between groups showed no statistically significant difference in the estimated path coefficients (CRD = 1.326). The findings suggest that academic self-efficacy is a relevant, although modest, statistical predictor of critical thinking among undergraduate students. The study contributes to higher education research by highlighting the importance of considering motivational factors alongside cognitive dimensions of higher-order thinking. These findings provide empirical insights into the relationship between academic self-efficacy and critical thinking within an Islamic university context.

Keywords: academic self-efficacy; critical thinking; higher education; self-regulated learning; Islamic university.

学业自我效能感作为高等教育批判性思维的基础性预测因素：来自伊斯兰大学的实证证据

摘要：本研究旨在探讨印度尼西亚克林奇国立伊斯兰学院（IAIN Kerinci）本科生学业自我效能感与批判性思维能力之间的关系。研究采用定量横断面相关性研究设计，通过比例分层随机抽样，从七个专业中选取160名本科生作为研究对象。数据收集采用基于社会认知理论、经过效度验证的学业自我效能感问卷，以及包含八道题目、用于评估批判性思维四个维度的高阶思维论述题测试。使用IBM SPSS Amos软件，采用最大似然估计法进行基于协方差的结构方程模型（CB-SEM）分析。测量模型表现出令人满意的构念信度和聚合效度，组合信度均高于0.80，平均方差提取量均高于0.50。结构模型的拟合程度达到可接受水平（$\chi^2/df = 1.87$，CFI = 0.94，TLI = 0.93，RMSEA = 0.067，SRMR = 0.051）。学业自我效能感与批判性思维能力呈显著正相关（$\beta = 0.34$，SE = 0.086，CR = 3.98，$p < 0.001$），可解释批判性思维能力约12%的变异（$R^2 = 0.12$）。按性别分层的分析结果表明，男性和女性学生的学业自我效能感与批判性思维能力均呈统计学显著的正向关联，而组间比较未发现估计路径系数存在统计学显著差异（CRD = 1.326）。研究结果表明，学业自我效能感是本科生批判性思维能力的一个具有一定预测意义但解释力相对有限的统计预测因素。本研究强调，在高等教育中研究高阶思维能力时，除认知维度外，还应重视动机因素的作用，从而为相关研究提供新的实证依据。研究结果进一步为理解伊斯兰大学教育背景下学业自我效能感与批判性思维能力之间的关系提供了实证参考。

关键词：学业自我效能感；批判性思维；高等教育；结构方程模型；伊斯兰大学。

1. Introduction

Students' critical thinking ability is a central concern in higher education, as this skill supports complex decision-making, problem-solving, and in-depth information comprehension and evaluation, making it a primary focus in efforts to enhance the quality of university learning. According to [1], [2], [3], [4], critical thinking represents a core competence that enables students to develop creativity, intellectual independence, and scientific capability as integral components of the academic process. Strong critical thinking skills allow students to analyze information, evaluate arguments, make well-reasoned decisions, and solve complex problems effectively and efficiently [4], [5], [6]. However, international research indicates that although critical thinking components have been incorporated into higher education curricula, the level of these skills often remains modest across institutions and does not develop optimally over time [7], [8], [9]. Similar findings have been reported in the Indonesian higher education context, where many students still demonstrate insufficient critical thinking skills, particularly in academic tasks, scholarly discussions, and interdisciplinary problem-solving [4], [8].

The persistently low level of critical thinking among university students has become a major concern

in higher education practice because this competence is a crucial prerequisite for academic and professional success in today's knowledge-driven era [2], [3]. Data on critical thinking–related competencies in Indonesia also reveal significant challenges at both secondary and tertiary education levels. Results from the Programme for International Student Assessment (PISA) 2022 show that higher-order thinking skills such as creative thinking and problem-solving—closely associated with critical thinking—remain low compared to the OECD average. Only about 31% of Indonesian students reached the baseline level of creative thinking proficiency (Level 3), and merely 5% achieved high proficiency levels (Levels 5–6), far below the OECD averages of 78% and 27%, respectively [10]. These findings indicate early difficulties in engaging in complex thinking activities, which are conceptually aligned with the critical thinking skills required at the university level [11] .

In the context of higher mathematics education, variation in students' critical thinking ability is clearly reflected in their performance on higher-order thinking skills (HOTS) problems that require deductive, evaluative, and reflective reasoning [12]. Studies involving mathematics education students indicate that only a small proportion of students consistently meet integrated indicators of analysis, evaluation, and inference, while the majority remain at a procedural level of problem-solving [13], [14]. Research conducted by [15], [16], [17] at a university revealed that among 30 mathematics education students, only about 20% demonstrated high levels of self-regulated learning, whereas most were categorized at moderate (63%) and low (17%) levels. Their HOTS test results varied, and the average critical thinking scores were inconsistent, suggesting that self-regulated learning alone does not guarantee optimal critical thinking performance [18], [19]. Furthermore, a descriptive study focusing on students' critical thinking in solving HOTS problems related to number concepts found that while some students were able to analyze and evaluate advanced mathematical problems adequately, abilities in interpretation, analysis, evaluation, and conclusion drawing showed sharp inter-individual differences [19], [20], [21]. This reflects substantial variability in critical thinking skills among mathematics students across several Indonesian universities.

Broader research also indicates that valid and reliable critical thinking assessment instruments for prospective mathematics teachers have been developed and tested on larger samples (245 respondents from 19 study programs), demonstrating that cognitive dispositions such as open-mindedness, systematicity, truth-seeking, and analyticity are valid indicators for measuring critical thinking ability in mathematics students [22]. This body of evidence suggests that although academic efforts have been made to understand and enhance critical thinking in higher mathematics education, students' critical thinking test outcomes remain heterogeneous and generally suboptimal, thereby providing a strong empirical basis for reinforcing the focus of the present study.

One internal determinant that has been consistently identified as related to higher-order cognitive performance is academic self-efficacy, defined as students' belief in their capacity to accomplish specific academic demands [23]. Within social cognitive theory, this construct is positioned as a mediator linking actual ability, motivation, and self-regulation in challenging learning situations [24]. Academic self-efficacy refers to individuals' beliefs in their capability to organize and execute the actions required to attain designated academic outcomes [25], [26]. Recent research indicates that students with high self-efficacy are more willing to explore new ideas, participate actively in classroom discussions, and demonstrate persistence when facing tasks that require higher-order thinking [25], [27], [28], [29]. In contrast, students with low self-efficacy tend to avoid difficult tasks, exhibit lower learning motivation, and lack confidence when encountering academic situations that demand critical analysis and [30], [31]. In Indonesia, educational studies such as those conducted by [23], [32], [33] have also reported positive correlations between academic self-efficacy and students' cognitive abilities, including decision-making and the construction of logical arguments, which are essential components of critical thinking.

The concept of self-efficacy has been widely discussed in educational literature as a key motivational factor influencing how students approach academic challenges and problem-solving strategies [32], [34], [35]. The conceptual link between self-efficacy and critical thinking can be explained through motivational and cognitive mechanisms, whereby confidence in one's ability affects strategy selection, effort intensity, and persistence in reflective reasoning processes [36] . Students who believe in their capabilities are more likely to engage in in-depth discussions, question assumptions, and critically evaluate evidence [37], [38], [39]. Conversely, fragile self-beliefs may limit cognitive engagement in higher-order thinking activities even when learning opportunities are available [40]. Several correlational and predictive studies in higher education have shown that self-efficacy contributes significantly to variation in critical thinking scores, although the magnitude of its effect is influenced by learning context and student characteristics [41], [42].

The low level of academic self-efficacy among university students often stems from prior learning experiences, high evaluation standards that are not accompanied by adequate instructional support, and the limited experience of academic success perceived by students when completing complex tasks [43], [44], [45]. When students lack sufficient opportunities to

experience success in academic contexts, their confidence in their own abilities tends to decline, which in turn affects their readiness to engage in learning activities that demand critical thinking [46], [47]. Moreover, teaching practices in some Indonesian higher education institutions that still emphasize lectures and rote learning further restrict students' opportunities to develop self-efficacy through active, challenging yet manageable learning experiences [48], [49], [50], [51]. This situation creates a cycle in which students feel uncertain about their academic capabilities and ultimately become reluctant to engage intensively in critical thinking processes.

Empirical evidence from the study by [41] also indicates that academic self-efficacy can predict various dimensions of university students' critical thinking, although its contribution to overall variance is relatively modest (approximately 8.1–12.2%), and interaction effects with gender were observed in some critical thinking dimensions. Other research examining similar relationships has reported that strengthening self-efficacy contributes to improvements in critical thinking across different higher education contexts, including argumentation skills and academic reasoning [52], [53]. Recent review studies further state that the relationship between self-efficacy and critical thinking has been consistently observed among diverse student populations across disciplines, although the magnitude of the relationship varies depending on research design and measurement instruments used [54], [55], [56].

However, understanding of the role of academic self-efficacy in relation to critical thinking remains limited, particularly within the context of higher education in Indonesia, including at IAIN Kerinci, which has distinctive academic cultural characteristics and instructional approaches. Few empirical studies have examined the predictive and structural relationship between psychological–cognitive factors within Islamic higher education institutions. Therefore, research that examines this relationship is necessary to enrich both international and local scholarly literature. The present study aims to examine the extent to which academic self-efficacy statistically predicts variation in students' critical thinking within the context of IAIN Kerinci, while providing theoretically grounded and contextually appropriate implications for higher education practice.

If the low levels of self-efficacy and critical thinking are left unaddressed, the consequences extend far beyond mere difficulties in completing academic tasks. The accumulation of weak critical thinking skills may hinder students' capacity to develop reflective abilities, evaluate information accurately, and construct coherent arguments, thereby negatively affecting the quality of graduates produced by higher education institutions [57], [58]. In the current digital era, where invalid and biased information spreads widely, the ability to think critically is essential for graduates to distinguish facts from opinions, critically engage with scientific literature, and make evidence-based decisions rather than relying on assumption [59], [60], [61]. When students lack these skills, the risk of becoming passive consumers of information increases, which in the long term may reduce the quality of their contributions to society and the workforce [62], [63]. In the Indonesian context, the impact of low critical thinking skills is also associated with reduced innovation and graduate productivity in the technology industry and other professional sectors, thereby weakening national competitiveness on a global scale [64], [65], [66], [67].

Addressing the problem of low self-efficacy and critical thinking requires instructional strategies that provide structured experiences of academic success, active learning that is challenging yet supportive, and strengthened psychological support for students. Strategies such as problem-based learning, collaborative learning, and research-based project work have been shown to significantly enhance academic self-efficacy and critical thinking skills across various international and local higher education contexts [68], [69], [70], [71]. Constructive feedback and evaluation systems that emphasize thinking processes and reflection also increase students' confidence in their ability to tackle demanding tasks [52], [55], [72]. Furthermore, technology-integrated learning and interactive digital resources can create more engaging learning experiences and allow students to test their hypotheses directly, indirectly strengthening both self-efficacy and critical thinking skills [54], [70], [73], [74]. These solutions are therefore selected because they empirically address the root causes of low self-efficacy and critical thinking, rather than merely treating the symptoms.

This study is important because empirical evidence remains limited regarding the predictive and structural relationship between academic self-efficacy and critical thinking in Indonesian higher education, particularly within the context of IAIN Kerinci. Previous studies have frequently examined these constructs through descriptive, correlational, or predictive approaches, while evidence from Islamic higher education institutions remains comparatively limited [70], [75], [76]. The present study therefore contributes empirical evidence on the extent to which academic self-efficacy statistically predicts variation in critical thinking within a specific Islamic higher education context. As an Islamic higher education institution, IAIN Kerinci has distinctive instructional characteristics in which character formation and spirituality are integral components. Examining the relationship between self-efficacy and critical thinking within this context may provide context-specific insights for curriculum development and instructional planning, while the findings should be interpreted within the boundaries of the cross-sectional design and the observed study population.

2. Methodology

2.1. Research Design

This study employed a quantitative approach with an explanatory correlational design aimed at examining the predictive relationship between academic self-efficacy and students' critical thinking ability. This design was selected because it enables the examination of statistical relationships among psychological and cognitive variables within a natural learning context without treatment manipulation. The research framework specified academic self-efficacy as the predictor construct and critical thinking as the criterion construct.

The study employed a cross-sectional survey design in which data were collected at a single point in time. Therefore, the structural analysis was intended to examine the statistical and predictive relationship between academic self-efficacy and critical thinking rather than to establish temporal precedence, causal direction, or causal effects. The proposed relationship between the constructs was examined using covariance-based Structural Equation Modeling (CB-SEM) implemented in IBM SPSS Amos, following preliminary data screening and assumption checks conducted using IBM SPSS Statistics. The CB-SEM analysis employed the Maximum Likelihood (ML) estimation method.

Table 1. Descriptive Statistics of The Research Sample

Characteristic	Category	n	%
Sex	Male	64	40.0
	Female	96	60.0
Study Program	Mathematics Education	24	15.0
	English Language Education	22	13.8
	Biology Education	23	14.4
	Islamic Education Management	25	15.6
	Early Childhood Education	21	13.1
	Islamic Religious Education	23	14.4
	Islamic Educational Guidance and Counseling	22	13.8

2.2. Population and Sample

The study population comprised all active undergraduate students in the Faculty of Education at IAIN Kerinci, Indonesia in the current academic year, representing seven study programs. The sample was determined using proportionate stratified random sampling to ensure representation across study programs and cohorts, allowing students' academic variability to be proportionally accommodated. The minimum sample size was calculated using a power analysis approach for regression/SEM models with an estimated medium effect size (0.30), a significance level of 0.05, and statistical power of 0.80, which generally recommends ≥150 respondents for predictive models with two latent variables (Hair et al., 2019; Kline, 2016). Inclusion criteria required students to have completed at least two semesters to ensure sufficient academic experience to evaluate their self-efficacy perceptions and critical thinking performance in Table 1.

Data were collected using a combination of psychometric questionnaires and cognitive tests to comprehensively capture affective–motivational dimensions and higher-order thinking performance. Academic self-efficacy was measured using a scale grounded in Bandura's theory that has been adapted to the higher education context, encompassing four primary dimensions: (1) strategy efficacy (confidence in selected strategies), (2) level efficacy (confidence in completing tasks of varying difficulty levels), (3) strength of effort (persistence in completing academic tasks), and (4) generality (confidence across different academic situations). This scale has demonstrated high internal reliability in higher education studies ($\alpha > 0.80$) as well as adequate construct validity.

2.3. Data Collection

The study population comprised all active undergraduate students in the Faculty of Education at IAIN Kerinci in the current academic year, representing seven study programs. The sample was determined using proportionate stratified random sampling to ensure representation across study programs and cohorts, allowing students' academic variability to be proportionally accommodated. The minimum sample size was calculated using a power analysis approach for regression/SEM models with an estimated medium effect size (0.30), a significance level of 0.05, and statistical power of 0.80, which generally recommends ≥150 respondents for predictive models with two latent variables (Hair et al., 2019; Kline, 2016). Inclusion criteria required students to have completed at least two semesters to ensure sufficient academic experience to evaluate their self-efficacy perceptions and critical thinking performance.

Table 2. Academic Self-Efficacy Instrument Test Results

Parameter	Value
Number of Item	24
Content validity (Aiken's V)	0.83 – 0.92
Item–total correlation	0.42 – 0.71
Cronbach's Alpha	0.89
Composite Reliability	0.91

The critical-thinking instrument consisted of eight Higher-Order Thinking Skills (HOTS) essay items designed to assess four dimensions of critical thinking: analyzing arguments, analyzing assumptions, evaluating evidence and arguments, and making decisions or inferences. Each essay item was assessed across all four dimensions rather than being assigned to a single dimension. Each dimension within an item was scored using an analytic rubric ranging from 0 to 4, with higher

scores indicating stronger performance on the corresponding critical-thinking dimension. Thus, each essay item had a maximum possible score of 16, obtained from the sum of the four dimension-specific rubric scores.

For the measurement analysis, the scores for each critical-thinking dimension were aggregated across all eight essay items. Accordingly, each dimension produced an aggregate score ranging from 0 to 32 and was subsequently specified as an observed indicator of the latent critical-thinking construct in the confirmatory factor analysis (CFA). The four observed indicators were therefore: (Y1) analyzing arguments, (Y2) analyzing assumptions, (Y3) evaluating evidence and arguments, and (Y4) making decisions or inferences. Thus, each of the four CFA indicators represented students' aggregated performance across all eight essay items rather than scores from individual items.

Prior to the main data collection, the instrument was subjected to content validity and item analysis. The Aiken's V coefficients ranged from 0.81 to 0.94, the item difficulty indices ranged from 0.36 to 0.68, and the discrimination indices ranged from 0.41 to 0.73. The internal consistency of the instrument was assessed using Cronbach's Alpha, which yielded a coefficient of 0.86. The use of Cronbach's Alpha was consistent with the polytomous scoring format of the essay instrument, in which responses were scored on a 0–4 rubric for each critical-thinking dimension.

The responses to the essay items were evaluated according to the scoring procedure established for the instrument. The resulting item scores were used to represent students' performance across the four specified dimensions of critical thinking. For the subsequent measurement analysis, the four dimensions were represented as observed indicators of the latent critical thinking construct. The critical-thinking instrument demonstrated satisfactory internal consistency, with a Cronbach's Alpha coefficient of 0.86.

Table 3. Critical Thinking Instrument Test Results

Parameter	Value
Number of Items	8 (HOTS essay items)
Content Validity (Aiken's V)	0.81 – 0.94
Difficulty Index	0.36 – 0.68
Discrimination Index	0.41 – 0.73
Reliability (Cronbach's Aplha)	0.86

The data collection procedure was conducted both online and offline with participants' informed consent and assurance of data confidentiality. This combination of affective and cognitive instruments enabled a more valid and comprehensive mapping of the relationship between academic beliefs and critical thinking performance.

2.4. Data Analysis

Data analysis was conducted using a single, sequential analytical framework. First, descriptive statistics and preliminary assumption checks were performed using IBM SPSS Statistics. These procedures included assessment of univariate normality, linearity, and multicollinearity to examine whether the observed data met the assumptions required for subsequent structural analysis. Second, confirmatory factor analysis (CFA) was conducted using IBM SPSS Amos to evaluate the measurement models of academic self-efficacy and critical thinking. The measurement models were assessed using standardized factor loadings, composite reliability (CR), and average variance extracted (AVE), while overall model fit was evaluated using the chi-square-to-degrees-of-freedom ratio (χ^2/df), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR).

After the adequacy of the measurement models had been established, the hypothesized structural relationship between academic self-efficacy and critical thinking was tested using covariance-based Structural Equation Modeling (CB-SEM) in IBM SPSS Amos. The structural model was estimated using the Maximum Likelihood (ML) estimation method. The structural relationship was evaluated using the standardized path coefficient (β), standard error (SE), critical ratio (CR), and p-value. The coefficient of determination (R^2) was also examined to determine the proportion of variance in critical thinking statistically accounted for by academic self-efficacy.

Finally, a gender-based multi-group analysis (MGA) was conducted within IBM SPSS Amos to examine whether the structural relationship between academic self-efficacy and critical thinking differed between male and female students. The structural path coefficients were first estimated separately for each gender group. A direct between-group comparison was then performed using the critical ratio for differences between parameters (CRD) to determine whether the difference between the ASE → CT path coefficients was statistically significant. The absolute CRD value was evaluated against 1.96 at the 5% significance level.

3. Findings

3.1. Measurement Model Test Results (CFA)

Confirmatory factor analysis (CFA) was conducted using IBM SPSS Amos as the measurement-model stage of the covariance-based SEM framework. The results indicated that all indicators of the Academic Self-Efficacy (ASE) and Critical Thinking (CT) constructs met the criteria for convergent validity, as they demonstrated standardized loading factors above 0.50 and high construct reliability, indicating that the indicators consistently represented the latent constructs being measured ([77] ;[78]) .

Table 4. CFA Academic Self-Efficacy Construct and Critical Thinking Results

Indicator	Dimension	Loading Factor	CR	AVE
X1	Strategy efficacy	0.82		
X2	Level efficacy	0.78		
X3	Strength of effort	0.74		
X4	Generality	0.64		
Construct ASE			0.91	0.56
Y1	Analyzing Arguments	0.85		
Y2	Analyzing Assumptions	0.73		
Y3	Evaluating Evidence and Arguments	0.68		
Y4	Decision-Making	0.61		
Construct CT			0.88	0.59

*AVE Value > 0.50 and CR > 0.70 indicate that convergent validity and construct reliability requirements were met (Hair et al., 2019).

Further analysis showed that the measurement model possessed adequate psychometric quality and was therefore suitable for testing structural relationships among constructs, as all indicators of academic self-efficacy and critical thinking exhibited factor loadings above the minimum threshold of 0.50, signifying substantial contributions to their respective latent constructs, along with composite reliability (CR) and average variance extracted (AVE) values exceeding recommended cutoffs for convergent validity and internal consistency. These findings suggest that the instruments were capable of measuring the constructs in a stable and accurate manner within the higher education student context [32], [54], [17]. This evidence aligns with the educational psychological measurement literature emphasizing that construct validity is a primary prerequisite before interpreting relationships among variables, as without a strong measurement foundation, structural parameter estimates risk being biased and unrepresentative of the underlying psychological phenomena [12], [20], [36].

For the critical thinking construct, the four observed indicators represented the four dimensions specified in the instrument: analyzing arguments, analyzing assumptions, evaluating evidence and arguments, and making decisions or inferences. The standardized factor loadings of the four indicators ranged from 0.61 to 0.85, indicating that each indicator contributed adequately to the measurement of the latent critical thinking construct. The composite reliability (CR) was 0.88 and the average variance extracted (AVE) was 0.59, supporting the reliability and convergent validity of the construct.

3.2. Goodness of Fit Model

The structural model demonstrated an adequate fit with the empirical student data, indicating that the latent relationship structure represented in the model was adequately consistent with the observed covariance patterns (Byrne, 2016; Kline, 2016). The results of the goodness-of-fit assessment are presented in Table 5.

Table 5. Indeks Goodness Of Fit Model SEM

Indeks Fit	Score Result	Criteria	Keterangan
Chi-square/df	1.87	< 3.00	Good
CFI	0.94	≥ 0.90	Good
TLI	0.93	≥ 0.90	Good
RMSEA	0.067	≤ 0.08	Good
SRMR	0.051	≤ 0.08	Good

The covariance-based SEM model was evaluated using IBM SPSS Amos. The results of the goodness-of-fit assessment are presented in Table 5, the model yielded a chi-square to degrees of freedom ratio (χ^2/df) of 1.87, a CFI of 0.94, a TLI of 0.93, an RMSEA of 0.067, and an SRMR of 0.051. The CFI and TLI values exceeded 0.90, while the RMSEA and SRMR values were below 0.08. The χ^2/df ratio was also within the specified range. Taken together, these indices indicated that the covariance structure represented in the model adequately corresponded to the observed data.

The satisfactory model fit provided an adequate basis for examining the structural relationship between academic self-efficacy and critical thinking. Accordingly, the structural path was subsequently evaluated based on the standardized path coefficient (β), standard error (SE), critical ratio (CR), and p-value.

3.3. Structural Model Test Results

The results of the prerequisite assumption tests indicated that the data met the statistical requirements for the subsequent SEM analysis, allowing valid interpretation of the predictive relationship between academic self-efficacy and critical thinking. Multivariate normality testing showed that standardized skewness and kurtosis values fell within the ±2 range, and the Kolmogorov–Smirnov/Shapiro–Wilk tests on composite scores were non-significant ($p > 0.05$), indicating that the data distribution approximates normality with no serious violation of normality assumptions. Linearity testing using ANOVA lack-of-fit analysis and scatterplot inspection between academic self-efficacy and critical thinking scores demonstrated a significant linear relationship ($p < 0.05$) without meaningful curvilinear deviation, confirming that a linear predictive model is appropriate to represent the relationship between the students' psychological

constructs. In addition, multicollinearity testing revealed Variance Inflation Factor (VIF) values below 3 and tolerance values above 0.30 for all predictor indicators, indicating the absence of high intercorrelations among independent variables and indicating that the observed variables did not show evidence of problematic multicollinearity in the preliminary diagnostic.

Table 6. Summary Of Assumption Tests (Normality, Linearity, And Multicollinearity)

Assumption	Indicator	ASE	CT	Criteria	Interpretation
Normality (Univariate)	Kolmogorov–Smirnov Sig.	0.200	0.173	Sig. > 0.05	Normal dist.
	Shapiro–Wilk Sig.	0.118	0.072	Sig. > 0.05	Normal dist.
Normality (Multivariate – AMOS)	Skewness C.R.	-1.812	-1.556	±2.58	Acceptable
	Kurtosis C.R.	1.274	1.118	±2.58	Acceptable
	Multivariate Kurtosis C.R.	-	1.602	±2.58	Multivariate normal
Linearity	Linearity Sig. (ASE → CT)	0.000	–	p < 0.05	Linear relationship exists
	Deviation from Linearity Sig.	0.274	–	p > 0.05	No significant deviation
Multicollinearity (SPSS)	Tolerance	0.742	–	> 0.10	No multicollinearity
	VIF	1.348	–	< 5.00	No multicollinearity

The structural path analysis indicated a positive and statistically significant predictive association between academic self-efficacy and critical thinking in the observed sample.

Table 7. Structural Model Path Coefficients

Correlation	β	SE	CR	p-value	Decision
ASE → CT	0.34	0.086	3.98	<0.001	Significant

The structural model showed a positive and statistically significant relationship between academic self-efficacy and critical thinking ($\beta = 0.34$, SE = 0.086, CR = 3.98, $p < 0.001$). This result indicates that higher levels of academic self-efficacy were statistically associated with higher levels of critical thinking in the observed sample. Given the cross-sectional design, this finding should be interpreted as evidence of a predictive statistical relationship rather than as evidence of a causal effect or temporal influence. This finding is consistent with the social-cognitive theoretical framework, which positions self-efficacy as an important motivational factor related to cognitive and motivational regulation in complex tasks. The statistical significance of this relationship is also consistent with empirical findings indicating that students with higher self-efficacy tend to employ metacognitive strategies, self-monitoring, and reflective reasoning, which are relevant to critical thinking processes in academic learning [22], [34], [42].

3.4. The coefficient of determination (R^2)

The coefficient of determination (R^2) for critical thinking was 0.12, indicating that academic self-efficacy statistically accounted for 12% of the variance in critical thinking. The remaining 88% of the variance may be associated with other psychological, instructional, and contextual factors that were not included in the present model. This result indicates that academic self-efficacy represents one relevant predictor of critical thinking, while its explanatory contribution remains limited within the observed sample.

Table 8. Explained Variance

Endogenous Variable	R^2	Interpretation
Critical Thinking	0.12	12% of variance explained

The finding is consistent with the multidimensional nature of critical thinking, which may be associated with multiple individual and learning-context factors. Accordingly, the R^2 value should be interpreted as the explanatory contribution of the predictor included in the present structural model rather than as evidence that academic self-efficacy independently determines critical thinking performance.

3.5. Gender Multi-Group Analysis

A gender-based multi-group analysis was conducted within IBM SPSS Amos to examine whether the structural relationship between academic self-efficacy and critical thinking differed between male and female students. The estimated structural path was positive and statistically significant in both groups.

Table 9. Gender-Specific Structural Path Coefficients

Group	β ASE → CT	CR	p
Male	0.29	2.87	0.004
Female	0.37	3.65	<0.001
CRD	1.326	-	Not sign.

Among male students, the path coefficient was $\beta = 0.29$ (CR = 2.87, $p = 0.004$), whereas among female students, it was $\beta = 0.37$ (CR = 3.65, $p < 0.001$).

To directly assess whether the difference between the two structural coefficients was statistically

significant, a critical ratio for differences between parameters (CRD) was examined. The resulting CRD was 1.326, which was below the absolute critical value of 1.96 at the 5% significance level. Thus, the difference between the ASE → CT path coefficients for male and female students was not statistically significant. Although the estimated coefficient was somewhat higher among female students, the direct between-group comparison did not provide statistical evidence of a gender-based difference in the strength of the ASE–CT relationship within the present sample.

The estimated coefficient was somewhat higher among female students than among male students. However, the significance of the structural path within each group does not establish whether the coefficients differ statistically between groups. Therefore, the results are interpreted as descriptive evidence of a similar positive association across gender rather than as evidence of structural invariance. A formal between-group comparison would be required to determine whether the difference in the structural coefficients is statistically significant.

The observation of a positive association in both gender groups suggests that academic self-efficacy is relevant to understanding variation in critical thinking among the male and female students included in the present sample. This finding is consistent with literature emphasizing the role of self-efficacy in students' academic engagement, self-regulation, and cognitive functioning [79], [80],[81]. However, the present results do not provide sufficient evidence to conclude that the underlying psychological mechanisms are equivalent across gender or that the findings can be generalized beyond the study population.

Between ASE and the dimensions of analysis, assumptions, evaluation, and decision-making, indicating preliminary associations among variables prior to structural modeling. In panel (B), the scatter distributions and regression lines illustrate the positive associations between ASE and the individual critical thinking dimensions, with dimension scores generally increasing alongside higher levels of self-efficacy. These patterns provide descriptive support for the positive relationship observed in the structural model. Furthermore, panel (C) presents a 3D plot illustrating the relationship between ASE, gender, and critical thinking, with relatively similar slope patterns across the two gender groups. Overall, the figure 1 provides a visual representation of the statistical associations between academic self-efficacy and critical thinking within the observed sample.

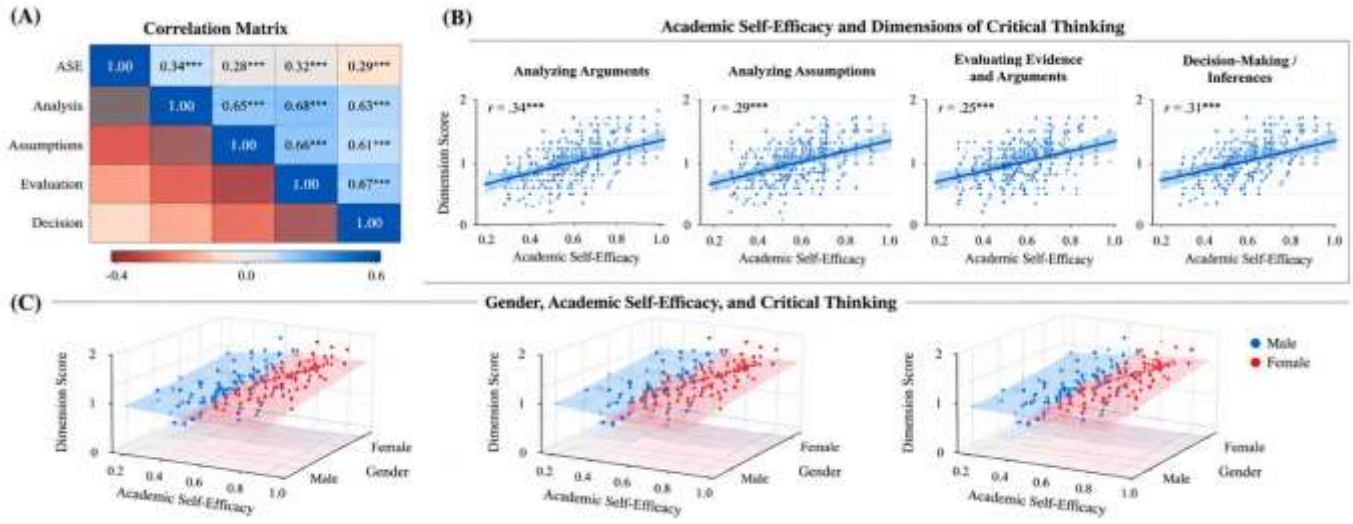

Figure 1. Statistical associations between academic self-efficacy and critical thinking. (A) Correlation matrix of the key study variables; (B) scatterplots with fitted regression lines showing the associations between academic self-efficacy and the individual dimensions of critical thinking; and (C) a three-dimensional scatterplot illustrating the relationship among academic self-efficacy, gender, and critical thinking.

4. Discussion

The principal finding of this study is that academic self-efficacy is positively and significantly associated with critical thinking in the observed sample. The structural model demonstrated a significant predictive association between academic self-efficacy and critical thinking ($\beta = 0.34$, $p < 0.001$), consistent with the social cognitive perspective that self-efficacy is related to students' motivational regulation, persistence, and engagement in challenging academic tasks [24], [82], [83], [84], [85], [86]. Students who hold stronger efficacy beliefs may be more inclined to persist in demanding academic activities, regulate their learning

processes, and engage with cognitively complex tasks [87], [88], [89]. However, because the present study used a cross-sectional design, the observed association should not be interpreted as evidence that academic self-efficacy temporally precedes or causes the development of critical thinking. Rather, the findings indicate that variation in academic self-efficacy is statistically related to variation in critical thinking within the observed student population.

Furthermore, the results explicitly demonstrate that academic self-efficacy plays a pivotal role as a foundational condition for the enhancement of students' critical thinking capacities, corroborating evidence that self-efficacy predicts multiple dimensions of critical thinking, albeit with relatively modest explained variance [16], [18]. In particular, self-efficacy exerts a direct and statistically significant influence on analytic thinking and open-mindedness, suggesting that students with stronger efficacy beliefs are more inclined to confront cognitively complex challenges and persist in the pursuit of academic rigor. The magnitude of the observed relationship also provides an important qualification to the interpretation of the findings. Academic self-efficacy showed a statistically significant association with critical thinking, but the model explained 12% of the variance in critical thinking. This indicates that academic self-efficacy represents one meaningful predictive factor within the present model, while a substantial proportion of the variance remains associated with other psychological, instructional, and contextual factors that were not examined. Accordingly, the findings support the theoretical relevance of self-efficacy for understanding differences in students' critical thinking, but they do not establish that strengthening self-efficacy alone would produce corresponding improvements in critical thinking. Future longitudinal or experimental research would be needed to examine whether changes in academic self-efficacy precede and contribute to changes in critical thinking over time. [90], [91], [92], [93]. Recent scholarship further emphasizes that complex task-based interventions—such as problem-based learning, inquiry-based learning, and project-based learning—yield more substantial gains in critical thinking when students possess adequate self-efficacy, as they are better prepared to manage cognitive uncertainty and sustained intellectual challenge [15], [29], [38], [41]. Therefore, these findings suggest that strengthening academic self-efficacy may enhance the effectiveness of pedagogical interventions explicitly designed to foster critical thinking.The stability of the effect of academic self-efficacy (ASE) on critical thinking (CT) across gender indicates that the underlying psychological mechanism is relatively universal within the higher education population, as multi-group analysis revealed no statistically significant differences in structural path coefficients between male and female students, thereby supporting broader generalizability of the model in tertiary education contexts [15], [46]. This evidence reinforces the position that academic self-efficacy operates as a core motivational belief that influences learning outcomes through comparable processes of self-regulation and cognitive engagement across demographic groups [3], [25], [91], [94].

Consequently, interventions aimed at strengthening self-efficacy—such as structured mastery experiences, formative and constructive feedback, and systematic academic social support—can be implemented inclusively without gender-based differentiation. Moreover, the findings extend prior scholarship by explicitly conceptualizing academic self-efficacy as a precondition [5], [37], [54], rather than merely a correlational variable in relation to critical thinking within Indonesian higher education, thereby contributing to the international discourse on motivational determinants of higher-order cognitive performance, particularly in Islamic educational settings that remain underrepresented in global research [33], [55], [85], [95]. From this perspective, instructional interventions that focus exclusively on cognitive task complexity without addressing students' efficacy beliefs risk producing suboptimal gains in critical thinking, as learners may lack sufficient confidence to consistently activate higher-order cognitive strategies [2], [19], [33], [82].

Beyond the statistical relationship identified in the present study, previous research has highlighted the potential of active learning approaches in supporting students' critical-thinking development, particularly when learning environments provide opportunities for exploration, reasoning, and active engagement [3], [94], [33]. In higher education contexts, the incorporation of relevant socio-religious issues may also provide meaningful contexts for students to construct rational and objective arguments and engage in analytical rather than uncritical reasoning. Within Indonesian Islamic higher education, the integration of educational values such as *adab*, moral reasoning, and *akhlak* into pedagogical practices, including case-based learning and structured academic discussion, has been discussed as a means of connecting students' cognitive and moral dimensions of learning [96], [97], [98]. Such an approach is particularly relevant in contemporary educational environments, where students are required to evaluate information critically while maintaining epistemic responsibility in increasingly complex digital and social contexts [99], [100]. These perspectives provide a broader pedagogical context for interpreting the present finding that academic self-efficacy is positively associated with critical thinking, while the specific effectiveness of particular instructional models or socio-religious pedagogical strategies was not directly examined in the present study.

Collectively, these findings provide a strong

empirical foundation for higher education policymakers and curriculum designers to prioritize not only conceptual mastery but also the systematic strengthening of students' academic self-efficacy. Professional development programs for educators should emphasize participatory and inquiry-driven instructional strategies that cultivate interactive learning environments. Future research should investigate additional moderating variables—such as learning motivation and environmental support—and adopt longitudinal designs to capture the developmental trajectory of students' critical thinking over time. Importantly, the integration of pedagogical and psychological approaches in instructional design is essential, as critical thinking development is optimized when accompanied by structured efforts to enhance self-efficacy through authentic mastery experiences, graduated task sequencing, scaffolding, and systematic reflection [101], [102], [103]. A learning environment that is emotionally and cognitively supportive enables students to construct robust efficacy beliefs regarding their capacity to manage complex tasks, ultimately promoting evidence-based argumentation [86]; [37], reflective evaluation [49], [58], [86], and sustained intellectual exploration [104], [105], [106]—the hallmarks of academic critical thinking.

5. Conclusion

This study demonstrates a positive and statistically significant predictive association between academic self-efficacy and critical thinking among undergraduate students at IAIN Kerinci. The structural model produced a standardized coefficient of $\beta = 0.34$ ($p < 0.001$), with academic self-efficacy accounting for 12% of the observed variance in critical thinking. These findings indicate that academic self-efficacy is a meaningful psychological factor for understanding variation in students' critical thinking within the present sample. However, the cross-sectional design does not permit conclusions regarding temporal precedence or causal effects. Therefore, the term "foundational predictor" in this study refers to the theoretical and statistical role of academic self-efficacy as a predictor within the structural model rather than a demonstrated causal mechanism. Future longitudinal and experimental studies are needed to examine whether changes in academic self-efficacy precede and contribute to changes in critical thinking over time.

Declarations

Author Contributions

Conceptualization, R.H., I.M.A., A.A., R., M.Y., and M.N.S; methodology, R.H. and I.M.A.; software, R.H.. and M.N.S; validation, I.M.A.. M.Y. and A.A.; formal analysis, R.H.; investigation, R.H. and M.Y. ; resources, R.H.; data curation, R.H. and M.N.S; writing—original draft preparation, R.H.; writing—review and editing, I.M.A. and A.A.; visualization, R.H.; supervision, I.M.A. and A.A.; project administration, R.H. and R.; funding acquisition, Not applicable. All authors have read and agreed to the published version of the manuscript.

Data Availability Statement

The data presented in this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy and ethical restrictions involving student research participants.

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Institutional Review Board Statement

Ethical review and approval were waived for this study because it involved a non-invasive educational survey with adult university students, posed minimal risk to participants, collected no sensitive personal information, and all data were analyzed anonymously.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study prior to data collection. Participation was voluntary, and all responses were anonymized to ensure participant confidentiality.

Conflicts of Interest

There are no conflicts of interest

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