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Soft Skills and Academic Achievement: The Mediating Effect of Critical Problem-Solving Ability among Mathematics Education Students

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ABSTRACT: This study aims to analyze the role of Critical Problem-Solving Ability (CPSA) in mediating the influence of soft skills on the academic achievement of students enrolled in the Mathematics Education Study Program, Faculty of Teacher Training and Education (FKIP), University of Islam Malang (UNISMA). The soft skills analyzed included adaptability and flexibility, collaboration and teamwork skills, effective communication skills, emotional intelligence, and independence and self-discipline. This research employs a quantitative approach with an explanatory-predictive survey design and path analysis technique using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS4 software. The sample consists of 99 students from the 3rd, 5th, and 7th semesters, selected using a convenient sampling technique. The research instruments include a standardized questionnaire and semester academic index (SAI) documents. The results show that certain soft skills variables, such as Adaptability and Flexibility (ADAF), Effective Communication Skills (ECS), and Independence and Self-Discipline (ISD), have a significant direct effect on CPSA. Additionally, ECS and ADAF also have a direct effect on SAI. CPSA was proven to have a direct effect on SAI and to serve as a significant mediator in the relationship between ADAF and ECS with SAI. However, no significant indirect effects were found from Collaboration and Teamwork Skills (CTS), Emotional Intelligence (EQ), and ISD on SAI through CPSA. These findings recommend integrating the development of soft skills and CPSA into the curriculum to enhance students' academic achievement. Learning programs should be designed holistically with a focus on strengthening soft skills and critical thinking abilities to support students' readiness in facing the challenges of education and the dynamic workforce.

Keywords: academic performance, critical problem-solving ability, mediation effect, multivariate analysis, soft skill.

ABSTRAK: *Penelitian ini bertujuan untuk menganalisis peran Critical Problem-Solving Ability (CPSA) dalam memediasi pengaruh soft skills terhadap prestasi akademik mahasiswa Program Studi Pendidikan Matematika FKIP Unisma. Soft skills yang dianalisis meliputi Adaptability and Flexibility, Collaboration and Teamwork Skills, Effective Communication Skills, Emotional Intelligence, serta Independence and Self-Discipline. Penelitian ini menggunakan pendekatan kuantitatif dengan desain explanatory-predictive survey dan teknik analisis jalur melalui Partial Least Squares Structural Equation Modeling (PLS-SEM) dengan software SmartPLS4. Sampel penelitian terdiri dari 99 mahasiswa semester 3, 5, dan 7 yang dipilih menggunakan teknik convenience sampling. Instrumen penelitian berupa kuesioner terstandar dan dokumen indeks prestasi semester (SAI). Hasil penelitian menunjukkan bahwa secara langsung, beberapa variabel soft skills seperti Adaptability and Flexibility (ADAF), Effective Communication Skills (ECS), dan Independence and Self-Discipline (ISD) berpengaruh signifikan terhadap CPSA. Selain itu, ECS dan ADAF juga berpengaruh langsung*

terhadap SAI. CPSA terbukti memiliki pengaruh langsung terhadap SAI dan berperan sebagai mediator yang signifikan untuk hubungan ADAF dan ECS terhadap SAI. Namun, tidak ditemukan pengaruh tidak langsung yang signifikan dari Collaboration and Teamwork Skills (CTS), Emotional Intelligence (EQ), dan ISD terhadap SAI melalui CPSA. Temuan ini merekomendasikan integrasi pengembangan soft skills dan CPSA dalam kurikulum pembelajaran untuk meningkatkan capaian akademik mahasiswa. Program pembelajaran harus dirancang secara holistik dengan fokus pada penguatan soft skills dan kemampuan berpikir kritis, guna mendukung kesiapan mahasiswa menghadapi tantangan pendidikan dan dunia kerja yang dinamis.

Kata kunci: *prestasi akademik, Critical Problem-Solving Ability, pengaruh mediasi, analisis multivariat, soft skill*

INTRODUCTION

The integration of soft skills into students' academic performance has become a central concern in contemporary higher education discourse, particularly in relation to critical thinking and problem-solving abilities. Soft skills such as effective communication, adaptability, teamwork, emotional intelligence, and self-reliance have been shown to play a pivotal role in students' academic and professional success. Developing interpersonal communication and collaboration skills is fundamental to academic achievement, as these competencies enable learners to engage effectively with peers and articulate their ideas with confidence (Horne & Rakedzon, 2024). In today's dynamic and competitive higher education environment, fostering soft skills is essential for preparing students to adapt to rapid social and technological change (Ngo, 2024; Muammar & Alhamad, 2023; Casali & Meneghetti, 2023).

Adaptability and flexibility are key predictors of students' success in navigating academic challenges. Empirical evidence suggests that students who can adjust to academic pressures and exhibit cognitive flexibility tend to demonstrate higher levels of resilience and academic performance (Amat et al., 2023). Structured collaboration facilitated by educators also contributes significantly to the development of these capacities (García et al., 2022). Moreover, flexible problem-solving strategies enhance persistence and comprehension of complex material (Hayati, Armanto, & Zuraini, 2023), as they encourage openness to change and readiness to face uncertainty (Feraco, Sella, et al., 2023).

Within collaborative learning environments, teamwork skills are indispensable. The contemporary workplace increasingly demands graduates who are not only academically proficient but also capable of working effectively within diverse teams (Chmelárová & Pasiar, 2023). Therefore, educational institutions must prioritize the integration of collaborative learning experiences to improve student outcomes (Chen, Ma, & Ma, 2024). Embedding teamwork and collaboration into the university curriculum is essential, as students who actively engage in team-based tasks tend to demonstrate deeper understanding and higher achievement by synthesizing multiple perspectives in problem-solving (Firdaus & Satriawan, 2025). Such collaboration fosters tolerance, respect for

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diversity, and greater learning motivation (Banerjee et al., 2024; Kelly, McLoughlin, & Finlayson, 2020; Kapur, 2024; Shahid et al., 2022).

Effective communication represents another critical soft skill. In academic settings, effective communication facilitates productive interactions between lecturers and students as well as among peers (Imelda & Mutilu, 2023; Çelik & Alpan, 2023; Jedi & Mojahed, 2024). Students who master communication skills are better able to express ideas, comprehend concepts, and contribute meaningfully to academic discourse (Ngo, 2024). These skills not only strengthen teamwork but also enhance emotional intelligence and critical thinking (Alyana, 2023; Pazos, Pérez-López, & González-López, 2022; Jadhav & Gupta, 2014).

Emotional intelligence—the ability to recognize, understand, and regulate emotions—also plays a vital role in academic success. Students with higher emotional intelligence are more capable of managing stress, sustaining motivation, and displaying positive social behaviors (Coronado-Maldonado & Benítez-Márquez, 2023; Halimi, Al Shammari, & Navarro, 2020). Moreover, emotional intelligence contributes to effective teamwork and healthy group dynamics, which in turn enhance academic achievement (Vizniuk, 2021; Parikh et al., 2024).

Independence and self-discipline further underpin academic achievement. Students who exhibit strong self-control can effectively manage their time, maintain motivation, and complete assignments without constant supervision (Geng & Wei, 2023; Michaelides & Durkee, 2021; Şimşir & Dilmaç, 2020). These attributes promote efficient learning management and better prepare students to face future professional challenges (Karimi & Farivarsadri, 2024; Magana et al., 2022).

Beyond these individual competencies, Critical Problem-Solving Ability (CPSA) serves as a crucial bridge linking students' interpersonal potential to tangible academic outcomes. CPSA encompasses the ability to analyze, evaluate, and systematically address complex problems (Kasim, Hazwan, & Puad, 2024). In an era marked by uncertainty and rapid change, this ability enables students to respond to challenges with logical and strategic reasoning (Prakong, 2024; Thorndahl & Stentoft, 2020). Empirical studies confirm that CPSA strengthens the relationship between soft skills and academic achievement (Aldulaimi, 2018; Anwar et al., 2019), as it empowers students to analyze complex situations, generate effective solutions, and apply them efficiently.

Educational practices such as collaborative projects and peer assessment have proven effective in cultivating both soft skills and critical thinking abilities. These approaches allow students not only to understand theoretical concepts but also to develop reflective and solution-oriented mindsets (Mariya et al., 2024). Consequently, higher education curricula should be designed to nurture these competencies in an integrative manner. Previous studies have indicated that the impact of soft skills on academic achievement is often indirect, mediated by cognitive variables such as critical thinking and problem-solving ability (Hsin & Xie, 2012; Feraco et al., 2023). Accordingly, Critical Problem-Solving Ability functions

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as a mediating mechanism that connects soft skills with academic success more effectively.

A holistic educational approach that integrates soft skills and CPSA is therefore essential for producing graduates who are not only academically competent but also well-prepared to face real-world challenges (Rastede & Pence, 2025). Within the context of FKIP Unisma, this integration is particularly relevant, given the demand for future teachers who possess not only subject mastery but also the ability to think critically and apply innovative solutions in classroom practice (Hasnawati et al., 2021; Casali & Meneghetti, 2023). Hence, this study employs a multivariate analytical approach to explore both the direct and indirect relationships among soft skills, Critical Problem-Solving Ability, and academic achievement.

Based on the foregoing discussion, the present study aims to examine the direct influence of soft skills—adaptability and flexibility, collaboration and teamwork, effective communication, emotional intelligence, and independence and self-discipline—on the academic achievement of FKIP Unisma students, as well as the mediating role of Critical Problem-Solving Ability. Through a multivariate analytical framework, this study seeks to contribute empirical insights to the development of a more integrative and contextually relevant teacher education curriculum aligned with the competencies required in the 21st century.

RESEARCH METHOD

This study employed a quantitative approach with a survey research design. The survey utilized an explanatory–predictive design implemented through Partial Least Squares Structural Equation Modeling (PLS-SEM) (Henseler, 2018). The explanatory–predictive design was used to examine the mediating role of Critical Problem-Solving Ability (CPSA) in the influence of soft skills—namely adaptability and flexibility (ADAF), collaboration and teamwork skills (CTS), effective communication skills (ECS), emotional intelligence (EQ), independence, and self-discipline (ISD)—on students' academic achievement at FKIP Unisma. This design enables the analysis of both individual and combined effects of the variables (Creswell & Creswell, 2018).

Primary data were collected for the exogenous variables (ECS, CTS, ISD, ADAF, EQ) and the mediating variable (CPSA) through a questionnaire survey. The endogenous variable, Semester Achievement Index (SAI), was obtained from students' academic transcripts (*Kartu Hasil Studi* or KHS) from semesters 1 to 3. Data collection was conducted among students of the Mathematics Education Study Program, FKIP Unisma, who were enrolled in semesters 3, 5, and 7. The research was carried out from April 17 to May 3, 2025, involving a total of 99 respondents.

Sampling was conducted using the convenience sampling technique, a non-probability method where participants were selected based on availability and willingness to participate (Golzar & Noor, 2022). This technique was chosen because the study population consisted of active students of the Mathematics

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Education Study Program who were easily accessible and relevant to the research context. The distribution of respondents across semesters is presented in Table 1.

Table 1. Respondents of the Mathematics Education Study Program, FKIP Unisma

Semester	Number of Students	Percentage (%)
Semester 3	16	16,7
Semester 5	30	30,3
Semester 7	53	53
Total	**99**	**100**

A sample size of 99 students meets the statistical power requirement for correlational or simple regression analysis in educational research. Following Brydges (2019), a minimum of 84 participants is required to achieve a statistical power of 0.80 at a 0.05 significance level with a medium effect size. Therefore, the sample size of 99 is considered adequate and representative for the target population.

All respondents received an information sheet and informed consent prior to participation. Participation was voluntary, with respondents retaining the right to withdraw at any time without penalty. Data confidentiality was strictly maintained, and all information was analyzed in aggregate form solely for academic purposes. Ethical clearance and formal approval were obtained from the Faculty of Teacher Training and Education (FKIP), Universitas Islam Malang (Unisma) prior to data collection.

Data were collected using questionnaires and documentation specifically designed to measure each research variable. The instruments included: (1) Effective Communication Skills Questionnaire for Mathematics Education, adapted from Melissa et al. (2023); (2) Collaboration and Teamwork Skills Questionnaire for Prospective Mathematics Teachers, adapted from Chen, Ma, & Ma (2024); (3) Independence and Self-Discipline Skills Questionnaire, adapted from Sal (2022) for self-discipline and Chairul (2021) for independent learning; (4) Adaptability and Flexibility Skills Questionnaire, adapted from Cignachi et al. (2023); (5) Emotional Intelligence Questionnaire, adapted from Febriana (2021); and (6) Critical Problem-Solving Ability Questionnaire, adapted from Alias et al. (2022). Meanwhile, data for the Semester Achievement Index (SAI) were collected through documentation of students' academic transcripts (KHS), representing their Grade Point Averages (GPAs) from semesters 1 to 3.

Data were analyzed using Path Analysis with Partial Least Squares Structural Equation Modeling (PLS-SEM) through SmartPLS 4 software. Path analysis was chosen to examine both direct and indirect relationships among variables and to identify whether learning style moderates the relationship between mathematical resilience, learning climate, and mathematical reasoning. According to Hair et al. (2019), PLS-SEM is a multivariate statistical approach that allows for the simultaneous estimation of complex causal relationships among latent variables for predictive, exploratory, and model development purposes. SmartPLS 4 was

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selected due to its suitability for studies with relatively small samples and complex model structures.

Following Yamin (2021), the evaluation of a PLS-SEM model involves two main stages:

Stage 1 : Instrument Feasibility Test through Reflective Measurement Model Evaluation (Outer Model). This stage assesses:

(a) Validity, including Convergent Validity (factor loadings > 0.708; AVE > 0.7; Communality > 0.5) and Discriminant Validity (cross-loadings > 0.7; square root of AVE > latent variable correlations; HTMT < 0.9) (Hair et al., 2023); and (b) Reliability, evaluated using Cronbach's Alpha (> 0.9) and Composite Reliability (> 0.9) (Hair et al., 2023).

Stage 2: Hypothesis Testing (Structural Model Evaluation). This stage includes analysis of both direct and indirect effects among exogenous and endogenous variables, as well as descriptive analyses.

The hypothesis testing section comprises the following components: (1) Structural Model Evaluation: The model is assessed using indicators such as *Chi-square, R^2, Q^2, SRMR, NFI, d_G,* and *d_ULS* (Hair et al., 2023); (2) Bootstrapping Procedure: Bootstrapping is applied to determine the statistical significance of (a) direct, (b) indirect, and (c) total effects. Significance is assessed through *R^2, adjusted R^2, F^2, outer loadings,* and *cross-loadings*, while *t-statistics* and *p-values* indicate the significance of each path coefficient (Rosseel, 2020); (3) Blindfolding Procedure: This predictive relevance test assesses the model's ability to predict latent variables. If $Q^2 > 0.05$, the model is considered to have sufficient predictive relevance (Rosseel, 2020).

The hypotheses tested in this study are as follows: (1) There is a direct effect of each soft skill variable—adaptability and flexibility, collaboration and teamwork skills, effective communication skills, emotional intelligence, and independence and self-discipline—on students' academic achievement; (2) There is an indirect effect of these soft skill variables on students' academic achievement through the mediating role of Critical Problem-Solving Ability (CPSA).

RESULTS AND DISCUSSION

This study aimed to examine and analyze the role of Critical Problem-Solving Ability (CPSA) as a mediating variable between soft skills and students' academic achievement in the Faculty of Teacher Training and Education (FKIP), Unisma. Data were collected from 99 active students enrolled in the Mathematics Education Study Program in semesters 3, 5, and 7. All analyses were conducted using the Partial Least Squares Structural Equation Modeling (PLS-SEM) method with SmartPLS 4 software. The analytical procedure included evaluating the measurement model (outer model), the structural model (inner model), multicollinearity testing, and both direct and indirect hypothesis testing

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Measurement Model Evaluation (Outer Model)

The measurement model evaluation was carried out to ensure that the instruments used met validity and reliability criteria. Tests included convergent validity, discriminant validity, indicator reliability, and internal consistency reliability. All indicators of the exogenous variables—Adaptability and Flexibility (ADAF), Collaboration and Teamwork Skills (CTS), Effective Communication Skills (ECS), Emotional Intelligence (EQ), and Independence and Self-Discipline (ISD)—showed outer loading values above 0.70, except for one item that was retained with a loading greater than 0.60.

The mediating variable CPSA and the endogenous variable Semester Achievement Index (SAI) also met convergent validity requirements, with AVE values above 0.50 and Composite Reliability (CR) values greater than 0.90. All constructs had Cronbach's Alpha values above 0.70, indicating that all instruments were reliable. The validity and reliability testing results can be observed in the main model diagram generated by the PLS Algorithm output in SmartPLS 4, as shown in Figure 1 (Outer Model).

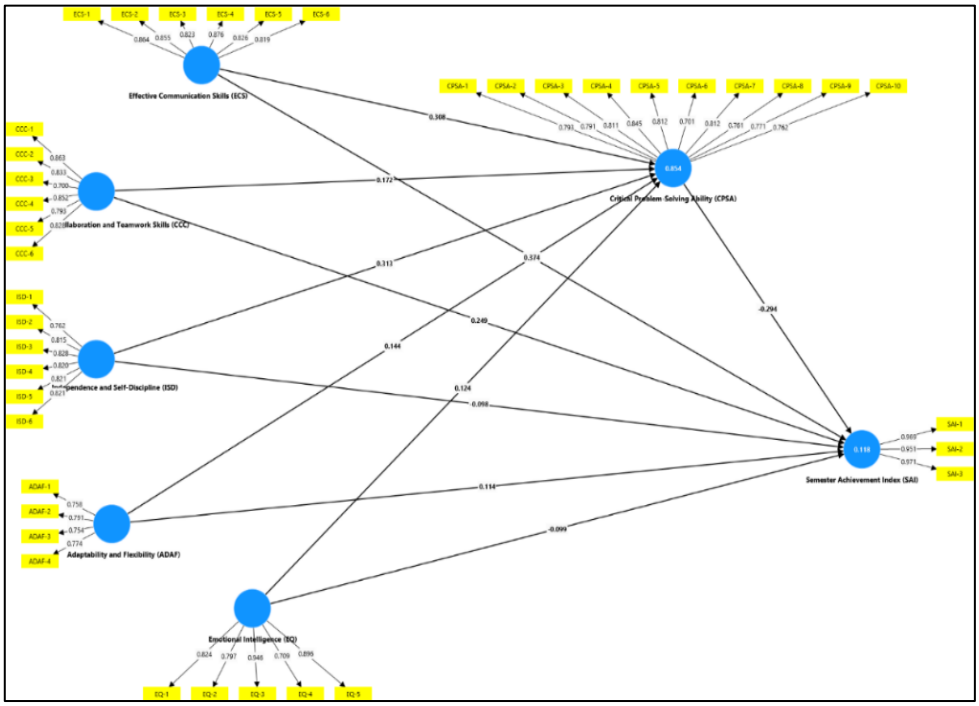

Figure 1. Main Model Diagram of PLS Algorithm Output (Outer Model)

The initial step, convergent validity testing, was conducted to determine the validity of each relationship between indicators and their respective latent constructs. As shown in Figure 2, all measurement items for each variable satisfied the validity requirements, as all loading factor (LF) values exceeded 0.70, and one exceeded 0.60. According to Dutta & Mandal (2018) and Garson (2016), these results confirm satisfactory convergent validity. Details of the outer loadings, Cronbach's Alpha, Composite Reliability (ρc), and Average Variance Extracted (AVE) are presented in Table 2.

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Table 2. Outer Loadings, Cronbachs Alpha, Composite Reliability, dan Average Variance Extracted

Variabel	Item	*Outer Loadings > 0.70*	Ket.	*Cronbach's Alpha > 0.70*	Composite reliability (rho_c) > *0.70*	*AVE > 0.50*	Exp
Variabel Eksogen							
Adaptability and Flexibility (ADAF)	ADAF-1	0.758	Valid	0.770	0.853	0.592	Reliable
	ADAF-2	0.791	Valid				
	ADAF-3	0.754	Valid				
	ADAF-4	0.774	Valid				
Collaboration and Teamwork Skills (CTS)	CTS-1	0.863	Valid	0.897	0.921	0.661	Reliable
	CTS-2	0.833	Valid				
	CTS-3	0.703	Valid				
	CTS-4	0.852	Valid				
	CTS-5	0.793	Valid				
	CTS-6	0.828	Valid				
Effective Communication Skills (ECS)	ECS-1	0.864	Valid	0.919	0.937	0.713	Reliable
	ECS-2	0.855	Valid				
	ECS-3	0.823	Valid				
	ECS-4	0.876	Valid				
	ECS-5	0.826	Valid				
	ECS-6	0.819	Valid				
Emotional Intelligence (EQ)	EQ-1	0.824	Valid	0.892	0.921	0.703	Reliable
	EQ-2	0.797	Valid				
	EQ-3	0.946	Valid				
	EQ-4	0.709	Valid				
	EQ-5	0.896	Valid				
Independence and Self-Discipline (ISD)	ISD-1	0.762	Valid	0.896	0.920	0.658	Reliable
	ISD-2	0.815	Valid				
	ISD-3	0.828	Valid				
	ISD-4	0.820	Valid				
	ISD-5	0.821	Valid				
	ISD-6	0.821	Valid				
Variabel Mediator							
Critical Problem-Solving Ability (CPSA)	CPSA-1	0.793	Valid	0.931	0.942	0.619	Reliable
	CPSA-2	0.791	Valid				
	CPSA-3	0.811	Valid				
	CPSA-4	0.845	Valid				
	CPSA-5	0.812	Valid				
	CPSA-6	0.701	Valid				
	CPSA-7	0.812	Valid				
	CPSA-8	0.761	Valid				
	CPSA-9	0.771	Valid				
	CPSA-10	0.762	Valid				
Variabel Endogen							
Semester Achievement Index (SAI)	SAI-1	0.969	Valid	0.962	0.979	0.929	Reliable
	SAI-2	0.951	Valid				
	SAI-3	0.971	Valid				

Remark: Ghasemy et al. (2021) reccomends the one-tailed 95% percentile confidence intervals (5%, 95%) of the reliability and validity statistics have been

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provided. CR = Composite Reliability (Composite Reliability Rho_c); AVE = Average Variance Extracted.

Based on Table 2, all outer loading (LF) values exceeded 0.70, fulfilling convergent validity criteria. Similarly, AVE values were greater than 0.50 for each variable, confirming good convergent validity. Discriminant validity was then tested to assess whether latent constructs were empirically distinct from one another (Hair et al., 2022). The Heterotrait-Monotrait (HTMT) ratio was used for this purpose, as suggested by Henseler et al. (2015). A summary of the results is presented in Table 3.

Table 3. Discriminant validity – Heterotrait Monotrait Ratio (HTMT)

Variable	ADAF	CTS	CPSA	ECS	EQ	ISD	SAI)
ADAF							
CTS	0.596						
CPSA	0.771	0.885					
ECS	0.650	0.894	0.891				
EQ	0.633	0.703	0.798	0.679			
ISD	0.723	0.810	0.893	0.824	0.815		
SAI	0.355	0.262	0.371	0.276	0.388	0.216	

As shown in Table 3, all HTMT values were below 0.90, confirming discriminant validity for all constructs (Hair et al., 2022; Henseler et al., 2015).

Reliability testing of the instruments included indicator reliability and internal consistency reliability. Internal consistency reliability reflects the degree to which indicators measuring the same construct are correlated. In PLS-SEM, Jöreskog's Composite Reliability (ρc) (Hair et al., 2022) is commonly used, where higher values indicate greater reliability. As shown in Table 2, all constructs exhibited high composite reliability values (ρc > 0.70), and Cronbach's Alpha values also exceeded 0.70 (Ghasemy et al., 2021). Thus, both indicator reliability and internal consistency reliability were established. The measurement model was therefore considered valid and reliable for further structural evaluation.

Structural Model Evaluation (Inner Model)

The structural model evaluation focused on hypothesis testing. Relationships between variables were represented by path coefficients. According to Edeh et al. (2023) and Ghasemy et al. (2021), structural model evaluation includes: (1) testing for multicollinearity assumptions in SmartPLS 4 (a prerequisite before bootstrapping), (2) model fit evaluation, and (3) structural model analysis through bootstrapping, where a *t*-statistic ≥ 1.96 or *p*-value ≤ 0.05 indicates a significant relationship. Additionally, the 95% confidence interval (CI) for each path coefficient was examined, and f^2 values were used to categorize effect sizes as small (0.02), medium (0.15), or large (0.35) (Hair et al., 2023). Indirect (mediating) effects were also assessed using *Upsilon V* (Lachowicz et al., 2018), categorized as low (0.01), medium (0.075), or high (0.175).

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Multicollinearity Assumption Test

The multicollinearity assumption test is a mandatory prerequisite before performing bootstrapping in the process of analyzing a Structural Equation Model (SEM). Interpretation of the data obtained from SmartPLS 4 can be reviewed through two indicators: (1) the Inner Model Variance Inflation Factor (VIF) values, and (2) the Model List Accumulative VIF values.

Many researchers prefer to use the Model List Accumulative VIF, as this indicator allows for a comprehensive interpretation of whether the data meet the multicollinearity assumption in a single view. The criterion for meeting the VIF requirement is that the VIF coefficient value should be ≤ 5.00. When a variable's VIF value exceeds this threshold, it indicates the presence of multicollinearity, suggesting that the data are not suitable for further bootstrapping analysis.

The multicollinearity test was conducted by examining the Variance Inflation Factor (VIF) values for each construct in the inner model. Table 4 presents the statistical results of the multicollinearity test.

Table 4. Collinearity Statistics (VIP)-Inner Model

Variabel Eksogen and Endogen Construction	**VIF < 5**
Adaptability and Flexibility (ADAF) -> Critical Problem-Solving Ability (CPSA)	1.652
Adaptability and Flexibility (ADAF) -> Semester Achievement Index (SAI)	1.795
Collaboration and Teamwork Skills (CTS) -> Critical Problem-Solving Ability (CPSA)	4.332
Collaboration and Teamwork Skills (CTS) -> Semester Achievement Index (SAI)	4.535
Critical Problem-Solving Ability (CPSA) -> Semester Achievement Index (SAI)	4.872
Effective Communication Skills (ECS) -> Critical Problem-Solving Ability (CPSA)	4.583
Effective Communication Skills (ECS) -> Semester Achievement Index (SAI)	4.234
Emotional Intelligence (EQ) -> Critical Problem-Solving Ability (CPSA)	2.387
Emotional Intelligence (EQ) -> Semester Achievement Index (SAI)	2.493
Independence and Self-Discipline (ISD) -> Critical Problem-Solving Ability (CPSA)	3.439
Independence and Self-Discipline (ISD) -> Semester Achievement Index (SAI)	4.113

Based on Table 4, the results of the collinearity testing for the latent variables were obtained. The collinearity test results in Table 4 show that the Inner VIF values for all combinations of exogenous, mediating, and endogenous latent variables are less than 5. This indicates that there is no multicollinearity present in the structural model. Therefore, the bootstrapping procedure can be carried out to test the research hypotheses.

Evaluation of Model Quality and Fit

1. Inner Model Feasibility Analysis through R-Square

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The R-square (R^2) test describes the proportion of variance in the endogenous variable that can be explained by the exogenous or other endogenous variables within the model. The coefficient of determination (R^2) values can be seen in Table 5.

Tabel 5. The Coefficient of Determination

Mediator and Endogen Variable	*R-square*	*R-square adjusted*	Interpretation
Critical Problem-Solving Ability (CPSA)	0.354	0.347	Low
Semester Achievement Index (SAI)	0.543	0.538	Moderate

Based on Table 5, the model is deemed suitable for further analysis based on the R-Square (R^2) and Adjusted R-Square values. The R^2 value for CPSA is 0.354 (classified as weak), and for SAI, it is 0.543 (classified as moderate). This means that 34.7% of the variance in CPSA is explained by the five dimensions of soft skills, while 53.8% of the variance in SAI is explained by the combined influence of the five soft skills and CPSA. Although the contribution to CPSA is relatively weak, the R^2 value for SAI is sufficiently strong to support both direct and mediating effect analyses. Furthermore, the R-Square value of all exogenous variables—ECS, CTS, ISD, ADAF, EQ, and the mediating variable Critical Problem-Solving Ability (CPSA)—on the endogenous variable Semester Achievement Index (SAI) is 0.543, with an Adjusted R-Square value of 0.538. This indicates that the entire exogenous construct (ECS, CTS, ISD, ADAF, EQ, and CPSA) collectively contributes 53.8% to the variance of the endogenous construct SAI. This result leads to the conclusion that the exogenous constructs as a whole exert a moderate influence on the endogenous construct.

The cumulative value of the Adjusted R-Square, amounting to 88.5% of the total 100%, reflects the proportion of explained variance of the complete construct toward the endogenous variable Semester Achievement Index (SAI). This means that the remaining 11.5% of the variance in the endogenous variable SAI is determined by other factors not examined in this study.

2. Feasibility Analysis of Standardized Root Mean Residual (SRMR) and Non-Fit Index in SmartPLS 4

In SmartPLS 4, the feasibility of a structural equation model is determined not only through R-Square analysis but also by evaluating the Standardized Root Mean Residual (SRMR) and the Non-Fit Index. The fundamental criteria for assessing model fit are as follows: (1) SRMR ≤ 0.10, (2) d_uls ≥ 0.05, (3) d_G ≥ 0.05, (4) Chi-square ≤ 3.00, and (5) NFI ≥ 0.80, which together indicate that the model achieves a good fit.

Table 6. Standarized Root Mean Residual and Non-Fit

	Saturated Model	Estimated Model	Kriteria Estimated Model	Interpretasi
SRMR	0.083	0.083	≤ 0.10	*Good Fit*
d_ULS	5.646	5.646	≥ 0.05	*Good Fit*
d_G	3.029	3.029	≥ 0.05	*Good Fit*

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Chi-square	14.121	14.121	≤ 3.00	*Fit*
NFI	0.665	0.665	≥ 0.80	Robust/ Acceptable fit

Based on Table 6, it can be categorized that all models fall within the good fit criteria, except for the chi-square value, which is in the range of ≥ 3.00, indicating that it does not fully meet the good fit criterion. However, the research model can still be considered fit or acceptable. Similarly, since the NFI value is below 0.80, the findings and the developed model can be regarded as robust.

A notable advancement in SmartPLS 4 is its ability to measure the degree of data reliability using two indicators: (1) d_ULS and (2) d_G. Based on this new interpretative approach, when the estimated model values for these indicators are ≥ 0.05, the collected data in the study can be classified as having a good fit in terms of reliability.

3. Feasibility Analysis through Predictive Relevance (Q^2)

Predictive relevance (Q^2) is a testing stage performed using the blindfolding procedure. Its purpose is to evaluate whether the dependent variable demonstrates predictive relevance with respect to the independent variables. The interpretation of the Q^2 value is relatively straightforward: when the $\sum Q^2 \geq 0$, the construct is considered to have predictive relevance toward its corresponding independent variables.

Table 7. Q^2 Predictive Relevance Value

Indikator	Q^2predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
CPSA-1	0.448	0.817	0.634	0.884	0.700
CPSA-2	0.446	0.744	0.598	0.880	0.701
CPSA-3	0.565	0.739	0.577	0.853	0.675
CPSA-4	0.543	0.764	0.580	0.858	0.661
CPSA-5	0.535	0.744	0.600	0.882	0.688
CPSA-6	0.468	0.833	0.657	0.930	0.688
CPSA-7	0.556	1.147	0.897	1.318	1.029
CPSA-8	0.469	1.237	0.970	1.286	1.024
CPSA-9	0.513	1.067	0.849	1.118	0.867
CPSA-10	0.526	1.124	0.911	1.194	0.953
SAI-1	0.057	0.189	0.150	0.227	0.181
SAI-2	0.041	0.241	0.172	0.281	0.207
SAI-3	0.059	0.212	0.151	0.251	0.186

Based on Table 7, it can be observed that the Q^2 results for all exogenous (independent) variables—ECS, CTS, ISD, ADAF, and EQ—with respect to the mediating variable Critical Problem-Solving Ability (CPSA) demonstrate predictive relevance ($Q^2 \geq 0.000$). Similarly, the overall exogenous constructs (ECS, CTS, ISD, ADAF, EQ, and the mediating variable CPSA**) each have Q^2 values ≥ 0.000 toward the endogenous (dependent) variable Semester Achievement Index (SAI).

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Therefore, based on the final data processing results from the blindfolding procedure, the dataset is considered appropriate for further analysis through bootstrapping to test the research hypotheses.

Hypothesis Testing (Structural Model Analysis)

1. Direct Effect Analysis

The analysis of the relationships among variables produced 11 interpretative structural models, as presented in Table 4.7. These relationships include: (1) The effect of ADAF on CPSA; (2) The effect of ADAF on SAI; (3) The effect of CTS on CPSA; (4) The effect of CTS on SAI; (5) The effect of CPSA on SAI; (6) The effect of ECS on CPSA; (7) The effect of ECS on SAI; (8) The effect of EQ on CPSA; (9) The effect of EQ on SAI; (10) The effect of ISD on CPSA, and (11) The effect of ISD on SAI.

The conclusions of the hypothesis testing are drawn based on the p-value ≤ 0.05, which represents the conventional 5% significance level in social and behavioral sciences. A t-statistic value ≥ 1.96 indicates a statistically significant effect within the model.

Table 8. Bootstrapping Direct Effect

Track Model	Path Coefficient (β)	T-Statistics	P-Values	PCI (Percentile Confidence Interval)	F^2	Conclusion
H1: ADAF -> CPSA	0.144	2.657	0.004	[0.056 , 0.234]	0.097	Accepted
H2: ADAF -> SAI	0.114	1.964	0.016	[0.111 , 0.258]	0.208	Accepted
H3: CTS -> CPSA	0.172	1.975	0.047	[0.005 , 0.336]	0.147	Accepted
H4: CTS -> SAI	-0.249	1.358	0.087	[-0.088 , 0.498]	0.016	Rejected
H5: CPSA -> SAI	0.294	1.974	0.035	[0.239 , 0.060]	0.314	Accepted
H6: ECS -> CPSA	0.308	3.412	0.000	[0.158 , 0.449]	0.142	Accepted
H7: ECS -> SAI	0.374	1.981	0.035	[0.040 , 0.560]	0.030	Accepted
H8: EQ -> CPSA	0.124	1.992	0.027	[0.017 , 0.231]	0.144	Accepted
H9: EQ -> SAI	-0.099	0.597	0.275	[-0.401 , 0.140]	0.034	Rejected
H10: ISD -> CPSA	0.313	3.770	0.000	[0.187 , 0.460]	0.196	Accepted
H11: ISD -> SAI	-0.098	0.519	0.302	[-0.488 , 0.117]	0.063	Rejected

Based on the results of the bootstrapping analysis of the direct effects among latent variables, an effect is considered significant when the T-statistic ≥ 1.96 or the p-value ≤ 0.05, and the 95% confidence interval (PCI) does not include the value of 0. Furthermore, the strength of the effect is determined using the f^2 value, with the following criteria: 0.02 = small, 0.15 = medium, and 0.35 = large (Hair et al., 2019).

H1: ADAF → CPSA (accepted). The test results show a path coefficient of 0.144, a T-statistic of 2.657 ≥ 1.96, and a p-value of 0.004 ≤ 0.05. The

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confidence interval [0.056 – 0.234] does not include 0, indicating a significant relationship. This means that an increase in ADAF significantly enhances CPSA. The f^2 value of 0.097 indicates a small-to-moderate effect.

H2: ADAF → SAI (accepted). The path coefficient is 0.114, T-statistic 1.964 ≥ 1.96, and p-value 0.016 ≤ 0.05. The confidence interval [0.111 – 0.258] excludes 0, confirming a significant influence. This implies that higher ADAF contributes to an increase in SAI. The f^2 value of 0.208 indicates a moderate effect, showing that ADAF has a fairly strong role in improving SAI.

H3: CTS → CPSA (accepted). The path coefficient is 0.172, T-statistic 1.975 ≥ 1.96, and p-value 0.047 ≤ 0.05, indicating a significant relationship. The confidence interval [0.005 – 0.336] does not include 0, reinforcing the result. The f^2 value of 0.147 indicates a medium effect, suggesting that CTS makes a meaningful contribution to CPSA improvement.

H4: CTS → SAI (rejected). The path coefficient is -0.249, with a T-statistic of 1.358 < 1.96 and a p-value of 0.087 > 0.05. The confidence interval [-0.088 – 0.498] includes 0, showing a non-significant effect. This means CTS has not been statistically proven to increase SAI. The f^2 value of 0.016 indicates a very small effect.

H5: CPSA → SAI (accepted). The path coefficient is 0.294, T-statistic 1.974 ≥ 1.96, and p-value 0.035 ≤ 0.05. The confidence interval [0.239 – 0.060] excludes 0, indicating a significant effect. CPSA significantly influences SAI improvement. The f^2 value of 0.314 suggests a moderate-to-large effect, showing that CPSA is an important factor in shaping SAI.

H6: ECS → CPSA (accepted). The path coefficient is 0.308, T-statistic 3.412 ≥ 1.96, and p-value 0.000 ≤ 0.05. The confidence interval [0.158 – 0.449] excludes 0, confirming a highly significant effect. ECS has a positive and significant influence on CPSA. The f^2 value of 0.142 (medium category) indicates a fairly strong relationship.

H7: ECS → SAI (accepted). The path coefficient is 0.374, T-statistic 1.981 ≥ 1.96, and p-value 0.035 ≤ 0.05. The confidence interval [0.040 – 0.560] excludes 0, indicating a significant effect. ECS contributes significantly to SAI improvement, although the f^2 value of 0.030 shows a relatively small effect despite statistical significance.

H8: EQ → CPSA (accepted). The path coefficient is 0.124, T-statistic 1.992 ≥ 1.96, and p-value 0.027 ≤ 0.05. The confidence interval [0.017 – 0.231] excludes 0, confirming a significant effect. This suggests that higher EQ leads to an increase in CPSA. The f^2 value of 0.144 indicates a medium effect.

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H9: EQ → SAI (rejected). The results show a path coefficient of -0.099, T-statistic 0.597 < 1.96, and p-value 0.275 > 0.05. The confidence interval [-0.401 – 0.140] includes 0, indicating a non-significant relationship. Thus, EQ has no significant impact on SAI. The f^2 value of 0.034 reflects a very small effect.

H10: ISD → CPSA (accepted). The path coefficient is 0.313, T-statistic 3.770 ≥ 1.96, and p-value 0.000 ≤ 0.05, showing a strong and significant effect. The confidence interval [0.187 – 0.460] excludes 0. The f^2 value of 0.196 indicates a moderate-to-large effect, suggesting that ISD plays an important role in enhancing CPSA.

H11: ISD → SAI (rejected). The path coefficient is -0.098, T-statistic 0.519 < 1.96, and p-value 0.302 > 0.05. The confidence interval [-0.488 – 0.117] includes 0, showing a non-significant effect. This means that changes in ISD do not have a significant impact on SAI. The f^2 value of 0.063 indicates a small effect.

Based on the results of testing eleven hypotheses, eight relationships were declared significant (H1, H2, H3, H5, H6, H7, H8, and H10), while the other three were insignificant (H4, H9, and H11). These findings suggest that most independent variables have a direct contribution to both CPSA and SAI. CPSA appears to be the most consistent variable that influences SAI, as shown by the values of the higher path coefficient and f^2 in the medium to large category. This confirms that CPSA plays an important role in bridging the influence of other variables on SAI. In other words, variables such as ADAF, CTS, ECS, EQ, and ISD are more strongly influencing SAI when mediated through CPSA enhancement. Meanwhile, the insignificance of the direct influence of CTS, EQ, and ISD on SAI indicates that these three variables do not directly strengthen SAI without going through CPSA. Overall, these results confirm the position of the CPSA as the dominant mediator linking several independent variables to the SAI.

2. Indirect (Mediating) Effects

Five indirect effect paths were tested to examine the mediating function of CPSA. This is further illustrated in the Path Coefficient and P-Values model presented in Figure 2.

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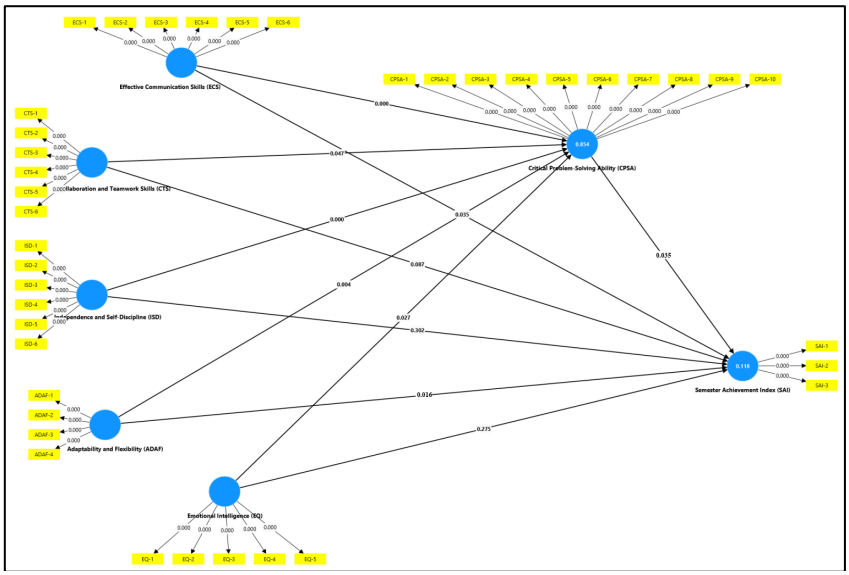

Figure 2. Path Coefficient, T-Statistic dan P-Values Model

The results of the hypothesis testing for indirect effects between the exogenous and endogenous variables can be seen in Table 9 below.

Table 9. Bootstrapping Results of Indirect Effects

Track Model	Path Coefficient (β)	T-Statistics	P-Values	PCI (Percentile Confidence Interval)	Upsilon V	Conclusion
H12: ADAF -> CPSA -> SAI	0.042	1.987	0.028	[0.110 , 0.217]	0.128	Accepted
H13: CTS -> CPSA -> SAI	-0.051	0.973	0.165	[-0.148 , 0.013]	0.063	Rejected
H14: ECS -> CPSA -> SAI	0.090	1.982	0.011	[0.280 ,0.418]	0.308	Accepted
H15: EQ -> CPSA -> SAI	-0.037	1.052	0.146	[-0.102 , 0.008]	0.031	Rejected

Based on Table 9, the indirect effect test was conducted to determine the mediating role of the CPSA variable in the relationship between independent variables and SAI. An indirect effect is considered significant when the T-Statistic ≥ 1.96 or the p-value ≤ 0.05, and the 95% confidence interval (PCI) does not include the value of 0. The magnitude of the mediation effect is indicated by the Upsilon V (υ) value, which is interpreted as 0.02 (low), 0.075 (moderate), and 0.175 (high) (Hair et al., 2021).

H12: ADAF → CPSA → SAI (accepted). The path coefficient value of 0.042, with a T-Statistic of 1.987 ≥ 1.96 and a p-value of 0.028 ≤ 0.05, indicates a significant indirect effect. The confidence interval [0.110 – 0.217] does not include zero, confirming this conclusion. This means that CPSA significantly mediates the effect of ADAF on SAI, implying that an increase in ADAF leads

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to an increase in SAI through CPSA. The Upsilon V value of 0.128 indicates a moderate mediation effect, reflecting a medium level of mediation strength.

H13: CTS → CPSA → SAI (rejected). The path coefficient of -0.051, T-Statistic of 0.973 < 1.96, and p-value of 0.165 > 0.05 indicate a non-significant effect. The confidence interval [-0.148 – 0.013] includes zero, confirming the insignificance. This suggests that CPSA does not significantly mediate the relationship between CTS and SAI. The Upsilon V value of 0.063 represents a weak-to-moderate mediation effect, reinforcing the weak mediating role of CPSA in this relationship.

H14: ECS → CPSA → SAI (accepted). The path coefficient of 0.090, with a T-Statistic of 1.982 ≥ 1.96 and a p-value of 0.011 ≤ 0.05, demonstrates a significant mediating effect. The confidence interval [0.280 – 0.418] does not include zero, indicating significance. This shows that CPSA serves as a significant mediator in the relationship between ECS and SAI. The Upsilon V value of 0.308 falls into the high category, suggesting a strong and substantial mediation effect of CPSA in this relationship.

H15: EQ → CPSA → SAI (rejected). The path coefficient of -0.037, T-Statistic of 1.052 < 1.96, and p-value of 0.146 > 0.05 indicate an insignificant effect. The confidence interval [-0.102 – 0.008] includes zero, suggesting no statistically significant mediation effect. The Upsilon V value of 0.031 indicates a weak-to-moderate mediation effect, meaning that the mediating role of CPSA in the relationship between EQ and SAI is very weak.

H16: ISD → CPSA → SAI (rejected). The path coefficient of -0.092, T-Statistic of 1.253 < 1.96, and p-value of 0.105 > 0.05 indicate a non-significant effect. The confidence interval [-0.214 – 0.019] includes zero, suggesting the absence of a meaningful mediation effect. The Upsilon V value of 0.028 falls into the weak-to-moderate category, indicating that the mediating strength of CPSA in the relationship between ISD and SAI is relatively weak.

Among the five indirect paths tested, two relationships were found to be significant (H12 and H14), while three were not (H13, H15, and H16). These findings indicate that CPSA effectively mediates the influence of ADAF and ECS on SAI, whereas its mediating effect is not statistically supported in the relationships of CTS, EQ, and ISD with SAI. The highest Upsilon V value (0.308) was observed in the ECS → CPSA → SAI path, signifying the strongest mediation effect among all the tested relationships.

Discussion

This study examines the relationship between various aspects of students' soft skills such as adaptability and flexibility (ADAF), collaboration and teamwork skills (CTS), effective communication skills (ECS), emotional intelligence (EQ), and

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independence and self-discipline (ISD) on the Semester Achievement Index (SAI), both directly and indirectly through Critical Problem-Solving Ability (CPSA). The results of the analysis show various relationships between these variables, which are discussed in stages below.

The Influence of Adaptability and Flexibility (ADAF)

The first (H1) and second (H2) hypotheses indicate that ADAF has a significant positive effect on CPSA and SAI. These findings are consistent with previous literature emphasizing the importance of adaptability in facing learning challenges, especially in fields such as mathematics education that require cognitive resilience and flexible thinking (Güngör & Baysal, 2024; Sin, 2022; (Waskito et al., 2024).

Flexible thinking supports students in changing their problem-solving strategies when previous strategies have failed. This plays an important role in building strong metacognition, which is awareness of one's own thinking (Khoshneshan et al., 2023). With the development of educational technology and the increasing complexity of academic tasks, students who are more adaptive have proven to be better able to cope with academic pressure and ambiguity (Feraco et al., 2023; Stockinger et al., 2021)

Directly, adaptive ability also influences SAI. These findings reflect the actual conditions in which students who quickly adapt to teaching methods, assessment systems, and curriculum changes have a greater chance of achieving good academic results. Learning environments that support flexibility, such as project-based learning and instructional personalization, have been shown to strengthen the relationship between ADAF and academic performance (Sahabuddin et al., 2024; Kokoç, 2019;Mirasol et al., 2023).

The Influence of Collaboration and Teamwork Skills (CTS)

The results of the third hypothesis (H3) state that CTS has a positive effect on CPSA, but the fourth hypothesis (H4) is rejected, indicating that CTS does not have a significant direct effect on SAI. These findings indicate that teamwork and collaboration do help students develop critical thinking and problem-solving skills, but their contribution to academic achievement (in the form of grades/GPA) may be more indirect or contextual.

Ma & Mazlan, (2024) and Chang & Tsai (2022) emphasize that effective collaboration encourages the exchange of ideas and enhances conceptual understanding through group discussions. However, some studies also show that CTS does not always have a direct impact on GPA or formal grades because formal academic success is influenced by other factors such as individual activity, academic writing skills, and learning strategies (De Prada, Mareque, & Pino-Juste, 2022; Pazos et al., 2022).

In the context of FKIP Unisma, these results highlight the importance of designing an assessment system that is able to accommodate the contribution of student teamwork so that its impact on academic achievement is more tangible.

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Otherwise, CTS will only become an additional skill that develops without being directly reflected in academic achievement indices.

The Influences of Effective Communication Skills (ECS)

The results of the analysis show that the sixth (H6) and seventh (H7) hypotheses are accepted, which means that *effective communication skills* (ECS) have a significant effect on *critical problem-solving ability* (CPSA) and on *the semester achievement index* (SAI). This shows that effective communication skills are not only social skills, but also an important cognitive driver in student academic achievement.

Students with high ECS are able to understand, formulate, and communicate problems more clearly, which is an important foundation for critical problem solving (Bilimleri & Dergisi, 2024). In the learning process, clear communication allows students to ask the right questions, convey logical ideas, and respond constructively to their peers' arguments, all of which are part of *the critical thinking cycle*.

Additionally, ECS directly supports academic achievement. Students who can communicate effectively are typically more active in class, better able to understand instructor instructions, and more successful in presentations and group work, which indirectly contributes to their *semester achievement index* (SAI) (Tariq & Ullah, 2024; Syeda & Naseer, 2020).

In the context of mathematics education at FKIP Unisma, ECS is very important because mathematics is not only about calculations, but also about explaining concepts, communicating logical arguments, and working together to solve problems. ECS also plays a major role in *peer teaching*, group discussions, and task reflection, all of which support academic achievement.

The Influence of Emotional Intelligence (EQ)

The eighth hypothesis (H8) was accepted, meaning that EQ has a significant effect on CPSA. However, the ninth hypothesis (H9) was rejected, meaning that EQ does not have a direct effect on SAI. This finding is interesting because it confirms the role of EQ as *an enabler* in building students' critical thinking skills, even though it does not directly contribute to academic grades.

EQ is closely related to students' ability to manage emotions when facing academic pressure, maintain focus when dealing with complex problems, and be open to criticism or failure. This is in line with the findings of Kim & Sohn (2019) EQ is closely related to students' ability to manage emotions when facing academic pressure, maintain focus when dealing with complex problems, and be open to criticism or failure. This is in line with the findings of which shows that EQ strengthens *academic self-efficacy*, and thus improves problem-solving skills.

However, EQ does not directly influence SAI because semester achievement indices are more influenced by cognitive abilities and learning strategies than by emotional management. In the context of mathematics, the focus is not only on emotional resilience but also on logical and analytical abilities.

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Studies by Miller (2024) and meta-analysis by Alabbasi, dkk. (2023) also reveal that the relationship between EQ and academic achievement is often weak and inconsistent, especially in fields that require high cognitive intelligence such as engineering and mathematics. An important implication of these findings is that EQ remains relevant, but more as a foundation that enables the development of other competencies such as CPSA, ECS, or CTS. This means that EQ needs to be developed as part of character and life skills learning, not merely as a predictor of academic achievement.

The Influence of Independence and Self-Discipline (ISD)

The tenth hypothesis (H10) was accepted, while the eleventh hypothesis (H11) was rejected. This means that ISD influences CPSA but does not directly influence SAI. These findings indicate that students who possess independence and self-discipline tend to be able to solve problems more critically and systematically. They can manage their time, devise strategies, and execute their study plans well. This is in line with research by Duckworth et al. (2019), Amalia and Jusra (2022), and Suryani et al. (2023) which shows that *self regulated learners* have higher problem-solving skills than passive students.

However, like EQ, ISD has not been proven to contribute directly to SAI. This is likely because SAI does not only depend on how diligent or disciplined students are, but also on the effectiveness of their learning strategies and how deeply they absorb the learning material. In addition, SAI often reflects the results of various forms of evaluation, not just independent work or time management (Krskova, et al., 2019; McBride, et al., 2019).

This context is important, students may already be disciplined, but if the learning methods and assessment systems do not support this independence, for example because the assignments are too structured or not challenging enough, then ISD cannot develop optimally.

After discussing the direct influence of each *soft skill* on *critical problem-solving ability* (CPSA) and *semester achievement index* (SAI), this section will discuss the results of the analysis of indirect influence through CPSA mediation. In addition, the implications of the findings for learning design and the importance of an integrative approach in higher education will also be discussed.

Mediation Role: CPSA as a Bridge between Soft Skills and Academic Achievement

1. ADAF → CPSA → SAI (H12)

The results of the analysis of hypothesis 12 show that CPSA significantly mediates the influence *of adaptability and flexibility* (ADAF) on SAI. This finding confirms that students who are able to adapt tend to have better problemsolving skills, and it is through these skills that they can achieve higher academic performance.

This finding supports the theory that *soft skills* such as adaptability do not directly improve GPA or grades, but have an indirect influence through cognitive skills such as CPSA. This is in line with the models proposed by She, et al. (2023) and Bordbar, et al. (2024), which place adaptability as the foundation for *academic*

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problem-solving and self-management. In other words, students' ability to persevere in a changing learning environment will strengthen CPSA and ultimately contribute to their academic achievement. The implication is that educational institutions need to design interventions that not only develop students' flexibility but also facilitate problem-solving practices in various contextual situations.

2. CTS → CPSA → SAI (H13)

Hypothesis 13 was rejected, indicating that there is no indirect effect of CTS on SAI through CPSA. This indicates that although CTS supports CPSA (direct effect), its contribution to academic achievement is not yet strong or statistically consistent.

There are several possible causes. First, student collaboration may not yet be implemented optimally at FKIP Unisma. Second, although teamwork helps CPSA development, the academic assessment context tends to still be individual, so that its impact on GPA or SAI is not apparent. As stated by Ngo (2024), Huri, et al. (2024), Nicole, et al. (2024) and Hoque, et al. (2023), Collaboration and Teamwork Skills (CTS) play an important role in the world of work, but their impact on IP is more noticeable when the learning and evaluation systems are truly project-based or team-based. Therefore, more systematic and meaningful collaborative learning is needed, along with evaluations that can assess individual contributions in teamwork so that the relationship between CTS and academic achievement through CPSA can be maximized.

3. ECS → CPSA → SAI (H14)

Hypothesis 14 is accepted, indicating that ECS indirectly influences SAI through CPSA mediation. This is one of the important findings in this study. Students with effective communication skills are not only able to convey ideas clearly, but are also better able to develop rational problem-solving strategies that can be applied in an academic context.

Studies by Liang and Kelsen (2018) and Tambunan (2021) confirm that ECS contributes to the success of groups in solving complex problems. Good communication accelerates the problem identification process, facilitates the search for alternative solutions, and enables the selection of the best strategy. Therefore, ECS should be seen not merely as a social skill, but as an integral part of critical and academic thinking competencies. The implication is that ECS training needs to be integrated into projectbased learning activities, peer discussions, and challenging presentation assignments. This will strengthen the connection between ECS, CPSA, and SAI.

4. EQ → CPSA → SAI (H15)

Hypothesis 15 is rejected. Although EQ influences CPSA (directly), its indirect influence on SAI is not significant. This shows that emotional intelligence is not yet sufficient to be the main driver of academic achievement through CPSA.

These findings reinforce the argument that EQ functions more as a stabilizer, facilitating interaction, reducing stress, and increasing resilience, but

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not as a strong predictor of academic learning outcomes like SAI. This is supported by the findings of Sorjonen, Melin, and Nilsonne (2024), Escudero-Lopez, et al. (2024), Chang and Tsai (2022) and Andreani (2013) who state that EQ has a small indirect effect on GPA, especially in science majors. Therefore, EQ training should focus on strengthening students' academic resilience and psychological well-being, and be combined with other cognitive development strategies.

5. ISD → CPSA → SAI (H16)

Hypothesis 16 was also rejected. Although ISD affects CPSA, its effect on SAI through CPSA is not significant. These findings indicate that independence and discipline do not necessarily result in higher academic achievement if they are not accompanied by effective learning strategies and the ability to overcome academic challenges.

According to Nabizadeh, et al. (2019) and Eteng-uket and Effiom (2024) learning strategies, not just discipline, are the main factors in academic achievement. Students who only rely on *Independence and Self-Discipline* (ISD) without developing critical thinking skills or adaptive learning strategies will find it difficult to achieve optimal academic performance.

CONCLUSION

The results of the study indicate that Critical Problem-Solving Ability (CPSA) serves as a significant mediator in the relationship between Adaptability and Flexibility (ADAF) and Effective Communication Skills (ECS) with students' Semester Achievement Index (SAI). Meanwhile, Independence and Self-Discipline (ISD), Emotional Intelligence (EQ), and Collaboration and Teamwork Skills (CTS) do not show a significant indirect effect on SAI through CPSA. This finding suggests that mastery of CPSA can bridge certain aspects of soft skills to academic achievement, but it does not apply universally to all types of soft skills. Therefore, developing critical thinking and problem-solving skills becomes an essential aspect in supporting the contribution of soft skills to students' academic success.

Based on these findings, it is recommended that curriculum development at FKIP Unisma, particularly in the Mathematics Education Study Program, integrate the training and reinforcement of soft skills proven to be significant—such as Adaptability and Flexibility and Effective Communication Skills—through learning approaches that foster CPSA. Lecturers should design active learning strategies such as problem-based learning, group discussions, and reflective presentations to encourage students' effective communication and critical thinking skills. In addition, institutional support in the form of non-academic skill training is also crucial to enhance students' readiness in facing academic and professional challenges holistically.

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