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Effectiveness of the APBAC Edu Model in Enhancing Critical Thinking Skills for 21st Century Learning

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Abstract
In response to the growing demand for higher-order thinking in 21st-century education, innovative learning models are needed to effectively enhance students' critical thinking skills. This study aims to test the effectiveness of the APBAC Edu learning model in enhancing critical thinking skills. This research used a quasi-experimental approach with a pretest-posttest control group design. The population was economics education students at the Faculty of Teacher Training and Education, Sriwijaya University, and sampling used simple random sampling, 68 students *Indralaya* class as the experimental group using the APBAC Edu model and 27 Palembang class as the control group using the problem-based learning model. The results showed that the average score for the experimental group increased from 6.60 in the pretest to 11.60 in the posttest, achieving an N-Gain of 0.59 (59.47%), which is categorized as moderate and effective. Meanwhile, the average score of the control group increased from 7.60 to 11.80 after the intervention, N-Gain of 0.45 (45.38%), which is considered moderate and less effective. The independent sample t-test showed a significance value of 0.000 <0.05, indicating a significant difference between the two groups. In conclusion, this research confirms that the APBAC Edu and PBL models are effective in improving critical thinking skills. However, the APBAC Edu model resulted in a greater increase in average scores compared to the PBL model. Therefore, it is recommended that the APBAC Edu model be implemented in courses which aims at developing higher-order thinking skills, such as accounting practicum courses.

Keywords: APBAC Edu model, critical thinking skills, 21st century learning transformation

INTRODUCTION

The rapid transformation toward Society 5.0 demands educational institutions to prepare graduates with 21st-century competencies that extend beyond content mastery to include higher-order thinking skills (HOTS). Critical thinking as one of the ten essential skills for future workforce success, has become a cornerstone competency that influences students' ability to analyze complex information, evaluate arguments, and make informed decisions in an increasingly interconnected world (World Economic Forum, 2020). However, despite its recognized importance, the development of critical thinking skills in Indonesian higher education faces significant challenges.

Recent empirical studies reveal concerning gaps in critical thinking development among Indonesian students. Critical thinking skills among secondary students remain predominantly in the moderate to low categories, primarily attributed to teacher-centered pedagogical approaches that limit student engagement in analytical processes (Suryadi & Nugraha, 2024). This finding aligns with broader research indicating that traditional lecture-based methods continue to dominate Indonesian classrooms, despite curriculum mandates for student-centered learning (Maknuna, 2019). The persistence of these pedagogical limitations creates an urgent need for innovative instructional models that can systematically develop critical thinking capabilities.

The urgency for addressing this educational challenge is further emphasized by the increasing complexity of global problems that require collaborative, multidisciplinary solutions. Twenty-first century learning must prioritize the development of critical thinking as a foundation for other essential competencies—creativity, communication, and collaboration (Sari & Wardhani, 2020). However, the implementation of effective critical thinking instruction remains inconsistent across Indonesian higher education institutions, creating a substantial gap between educational aspirations and actual learning outcomes (Ramadhani et al., 2024; Setiawan & Jumadi, 2020).

Extensive research has demonstrated the effectiveness of collaborative learning approaches in developing critical thinking skills. The structured collaborative learning environments yield significantly better results in developing higher-order thinking skills compared to conventional instructional methods (Hidayah et al., 2020). Their research emphasizes the importance of clearly defined roles and systematic interaction patterns in collaborative learning designs. Collaborative learning models based on critical thinking show superior effectiveness when they incorporate structured peer interaction mechanisms (Kurniawan & Indrawati 2024). Problem-Based Learning (PBL) has emerged as another powerful pedagogical approach for critical thinking development. A comprehensive meta-analysis revealed that PBL approaches have a strong positive effect on critical thinking skills, with an effect size of 3.1, indicating substantial educational impact (Nastiti et al., 2021). Critical thinking-oriented adaptations of PBL models show enhanced effectiveness when they incorporate collaborative elements and authentic problem-solving contexts (Yu & Zin, 2023).

However, despite the documented effectiveness of both collaborative learning and PBL approaches, research examining their integration within a unified instructional model remains limited. Need for systematic scaffolding in problem-based learning environments, suggesting that structured collaborative frameworks could enhance PBL effectiveness. This gap in research points to the potential benefits of integrating collaborative learning techniques with problem-based approaches within a comprehensive instructional model.

The role of academic culture in supporting critical thinking development has gained increasing recognition in recent educational research. A systematic review revealing that academic culture encompasses collaborative norms, reflective traditions, and scholarly conventions that significantly influence students' critical learning outcomes (Tikhonova et al., 2023). Their research emphasizes that a conducive academic environment, characterized by intensive scholarly discussions and reflective interactions, serves as a significant predictor of students' cognitive development and higher-order thinking skills.

Current educational practices in Indonesian higher education reveal several critical problems that impede effective critical thinking development. First, the predominant use of lecture-based instruction limits opportunities for students to engage in analytical reasoning and evaluative thinking processes (Suryadi & Nugraha, 2024). Second, when collaborative learning is implemented, it often lacks the structured role definitions necessary to ensure meaningful peer interaction and individual accountability (Susanti et al., 2025). Third, problem-based learning implementations frequently lack the systematic scaffolding required to guide students through complex analytical processes (Alsuwailan & Al-Shurai, 2025).

Furthermore, the academic culture component, which research has shown to be crucial for critical thinking development, is rarely systematically integrated into instructional design. This creates a disconnect between individual learning activities and the broader academic environment that should support reflective, analytical thinking. The absence of integrated approaches that combine collaborative learning, problem-based instruction, and academic culture support represents a significant gap in current educational practice.

Several alternative approaches could potentially address the identified challenges in critical thinking instruction. Traditional enhancement of lecture-based instruction through technology integration represents one possible solution, but research consistently shows limited effectiveness in developing higher-order thinking skills (Gonzales, 2019). Pure collaborative learning approaches, while effective in promoting peer interaction, may lack the authentic problem-solving contexts necessary for meaningful critical thinking development (Hussin, et al., 2019).

Standalone Problem-Based Learning implementation offers another alternative, with demonstrated effectiveness in critical thinking development. However, PBL effectiveness varies significantly based on implementation quality and structural support systems (Yohannes & Tamur, 2021). Their meta-analysis revealed that PBL approaches show enhanced effectiveness when combined with systematic collaborative frameworks and supportive academic environments. The integration of multiple pedagogical approaches within a unified model represents the most promising solution for addressing the complex challenges of critical thinking development. Recent research demonstrated that integrated instructional models combining multiple evidence-based approaches yield superior learning outcomes compared to single-approach implementations (Putri et al., 2023). This finding supports the development of comprehensive models that address multiple dimensions of critical thinking instruction simultaneously.

Based on the identified problems and research evidence, this study proposes the APBAC (Analytic Team Problem-Based Learning based on Academic Culture) Edu model as an integrated solution for critical thinking development. This model synthesizes three evidence-based components: structured collaborative learning through analytic teams, authentic problem-solving through Problem-Based Learning, and systematic

academic culture integration. The analytic team component draws collaborative learning framework, implementing specific analytical roles including summarizer, accuracy checker, theory validator, and questioner (Barkley et al., 2016). This structure addresses the identified need for systematic role definition in collaborative learning environments while ensuring individual accountability and meaningful peer interaction. The Problem-Based Learning component provides authentic problem-solving contexts that challenge students to apply theoretical knowledge to real-world situations. This addresses the need for meaningful application opportunities that go beyond superficial content engagement. The academic culture component systematically integrates scholarly norms, reflective practices, and critical evaluation standards into the learning process, creating a supportive environment for sustained critical thinking development. The integration of these three components within the APBAC Edu model represents a novel approach to critical thinking instruction that addresses the multifaceted nature of higher-order thinking development. This integrated approach is expected to yield superior learning outcomes compared to single-approach implementations while providing a replicable framework for broader educational application.

This research aims to evaluate the effectiveness of the APBAC Edu model in enhancing critical thinking skills among economics education students. The study addresses a significant gap in educational research by testing the integration of collaborative learning, problem-based instruction, and academic culture support within a unified instructional model. The findings are expected to provide both theoretical contributions to educational research and practical guidance for educators seeking to enhance critical thinking instruction in higher education settings.

The significance of this research extends beyond immediate pedagogical implications to address broader educational transformation needs in Indonesian higher education. As institutions strive to prepare graduates for the demands of Society 5.0, effective models for critical thinking development become essential tools for educational innovation. The APBAC Edu model, if proven effective, could serve as a framework for curriculum reform and faculty development initiatives aimed at enhancing 21st-century learning outcomes.

METHOD

This study employed a quasi-experimental approach using a pretest-posttest control group design. This design allowed the researcher to evaluate the effect of different instructional models on students' critical thinking skills by comparing the performance of an experimental group and a control group before and after treatment. The population consisted of all economics education students at the Faculty of Teacher Training and Education, Sriwijaya University, during the 2024–2025 academic year. The sample was selected using simple random sampling, resulting in 68 students from the *Indralaya* campus who were enrolled in the Accounting Practicum course and assigned as the experimental group receiving instruction through the APBAC Edu model. Meanwhile, 27 students from the Palembang campus formed the control group and were taught using the problem-based learning (PBL) model.

Data collection focused on assessing students' critical thinking skills through a pretest and posttest design. The instrument used was a multiple-choice test comprising fifteen items that had been designed to measure various aspects of critical thinking. Both groups completed the test before and after the instructional interventions to determine the extent of improvement in their critical thinking abilities. The test items were developed

based on established indicators and were subjected to validation and reliability testing to ensure the accuracy and consistency of the measurements.

Data analysis began with preliminary inferential tests to verify the assumptions for further statistical analysis. These included tests of normality and homogeneity to ensure the data met the requirements for parametric testing. Subsequently, an independent samples t-test was conducted to determine whether there was a statistically significant difference between the posttest scores of the experimental and control groups. Here is the conceptual framework.

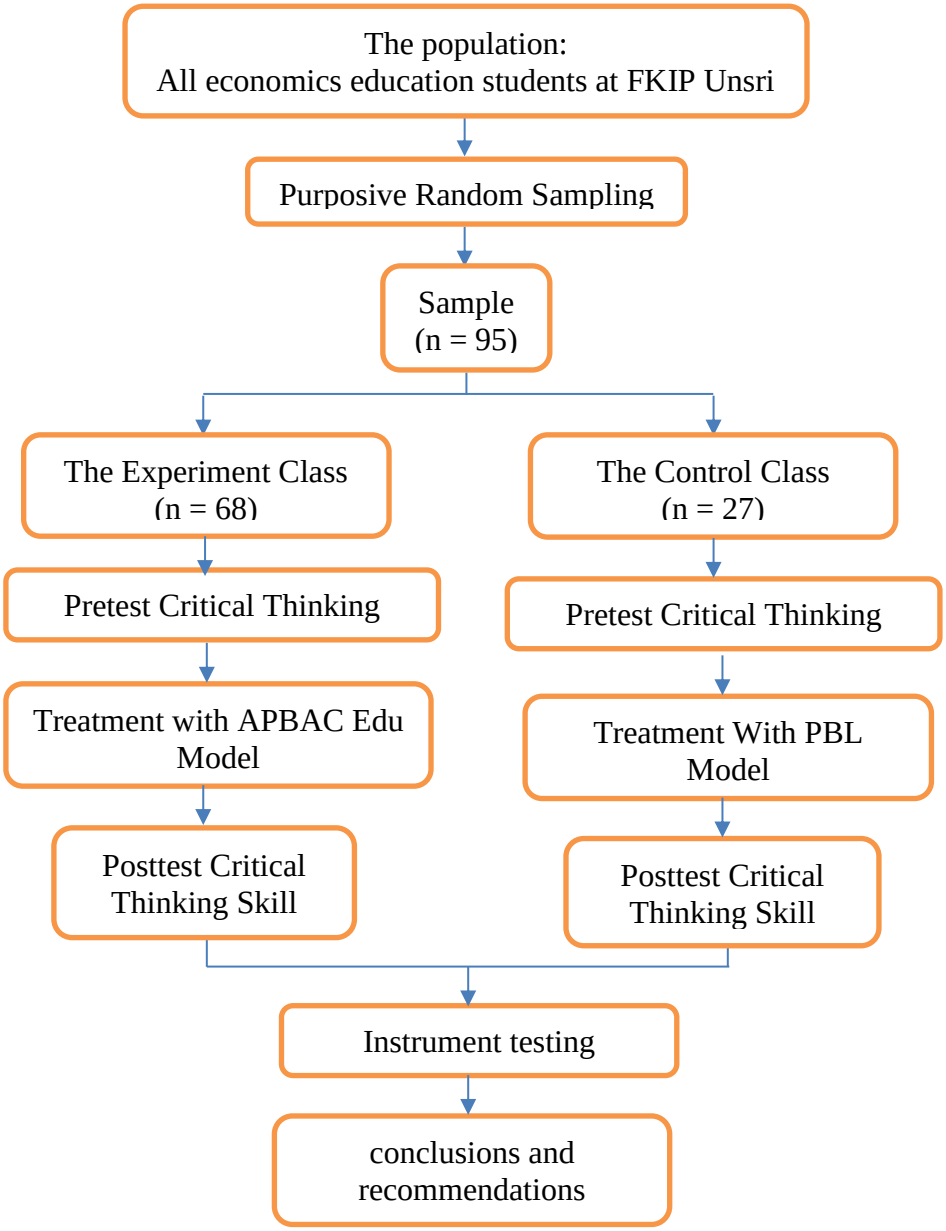

Figure 1. Conceptual Framework

FINDINGS AND DISCUSSION

Findings

Descriptive Analysis Results

This study aims to evaluate the effectiveness of the APBAC Edu model in improving critical thinking skills. The data used in this research are quantitative, obtained from critical thinking tests given to students taking the accounting practicum course in Economics Education. The *Indralaya* class was designated as the experimental group, while the Palembang class functioned as the control group. The descriptive analysis results for both classes' test scores are presented in Table 1 below.

Table 1. Results of Descriptive Analysis of Critical Thinking Skill Test Data

No.		Experiment Class		Control Class	
		Pre-test	Post-test	Pre-test	Post-test
1.	Number of Respondents	68	68	27	27
2.	Average	6,6	11,6	7,6	11,8
3.	Lowest Score	1	9	4	6
4.	Highest Score	12	15	12	14

As shown in Table 1, the experimental class had a minimum pretest score of 1, while the control class's lowest pretest score was 4. Both classes shared the same highest pretest score of 12. For the posttest, the experimental class's lowest score was 9, compared to 6 in the control class. The experimental class achieved 15 for the highest posttest score, while the control class reached 14. The experimental class recorded an average pretest score of 6.6, whereas the control class had an average of 7.6. For the posttest, the experimental class obtained an average score of 11.6, and the control class recorded an average of 11.8.

Table 2 Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test Control	.175	27	.033	.941	27	.132
Post-test Control	.154	27	.101	.938	27	.111
Pre-test Experiment	.114	27	.200*	.979	27	.836
Post-test Experiment	.114	27	.200*	.966	27	.509

The normality test using Shapiro-Wilk indicated that the significance value for the experimental class pretest was $\pi = 0.132$, while the posttest was $\pi = 0.111$, both exceeding $p > 0.05$, suggesting normal distribution. In the control class, the pretest significance value was $\pi = 0.836$ and the posttest was $\pi = 0.509$, also confirming normal distribution in both groups.

Following this, a homogeneity test was performed to examine whether the variances among groups were equal. As presented in Table 3, the results showed that all groups had homogeneous variances, fulfilling the assumptions required to proceed with t-test analysis. The homogeneity test results showed that all groups had homogeneous variances ($p > 0.05$), fulfilling the assumptions required for t-test analysis.

Table 3. Test of Homogeneity

		Levene Statistic	df_1	df_2	Sig.
Results	Based on Mean	1.774	3	186	.154
	Based on Median	1.439	3	186	.233
	Based on Median and with adjusted df	1.439	3	168.118	.233
	Based on trimmed mean	1.723	3	186	.164

The independent sample t-test results showed a two-tailed p-value of 0.000 < 0.05 for both groups, leading to rejection of H_0. This indicates significant differences in students' average critical thinking skills before and after learning with both models. The results showed that the average score for the experimental group increased from 6.60 in the pretest to 11.60 in the posttest, achieving an N-Gain of 0.59 (59.47%), categorized as moderate and effective. The control group's average score increased from 7.60 to 11.80, with an N-Gain of 0.45 (45.38%), considered moderate and less effective.

Following the normality and homogeneity tests, hypothesis testing was carried out using an independent sample t-test. The outcomes of this test are presented in Figure 2 below. From the pretest and posttest t-test results for the control class's critical thinking skill, a two-tailed p-value (T<=t) of 0.000 < 0.05 was found, leading to the rejection of H_0. This indicates that there was a significant difference in the students' average critical thinking skills before and after learning with the PBL model. Likewise, in the experimental class, the two-tailed p-value (t<=t) was also 0.000, which is below 0.05, resulting in the rejection of H_0. This finding demonstrates that the APBAC Edu model produced a significant improvement in students' average critical thinking skill following its implementation in the learning process. The hypotheses tested are:

H_0: There is no difference in the average increase in critical thinking skill of students before and after learning with the APBAC Edu model.

H_1: There is a difference in the average increase in critical thinking skill of students before and after learning with the APBAC Edu model.

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest Eksperimen - Posttest Eksperimen	-4.353	1.619	.196	-4.745	-3.961	-22.177	67	.000
Pair 2	Pretest Kontrol - Posttest Kontrol	-2.704	1.706	.328	-3.378	-2.029	-8.237	26	.000

Figure 2. T-Test

Discussion

Effectiveness of APBAC Edu Model in Improving Critical Thinking Skills

The findings of this study demonstrate that the APBAC Edu model is significantly more effective than the traditional Problem-Based Learning (PBL) model in enhancing students' critical thinking skills. The experimental group showed a higher N-Gain (59.47%) compared to the control group (45.38%), indicating superior learning outcomes

with a medium to large effect size. This finding aligns with recent research found that structured collaborative learning approaches yield better results in developing higher-order thinking skills compared to conventional methods, with effect sizes ranging from 0.6 to 0.8. (Hidayah et al., 2020).

The effectiveness of the APBAC Edu model can be attributed to its integration of three key components: analytic team roles, problem-based learning, and academic culture. This integration creates a comprehensive learning environment that addresses multiple dimensions of critical thinking development. Similar findings were reported emphasized that critical thinking-oriented adaptations of problem-based learning models show superior effectiveness when they incorporate structured collaborative elements, with improvement rates of 45-65% in various educational contexts. (Yu & Zin, 2023).

The superior performance of the APBAC Edu model over traditional PBL can be explained through the lens of cognitive load theory. The structured analytic team roles distribute cognitive processing among team members, reducing individual cognitive overload while maintaining high levels of analytical engagement. That systematic role distribution in collaborative learning environments leads to enhanced metacognitive awareness and improved critical thinking performance (Susanti et al., 2025).

This model offers benefits that extend beyond merely improving critical thinking skills; it also contributes to fostering positive academic behaviors and increasing students' active participation throughout the learning process. Nonetheless, the success of this model largely relies on the lecturer's effectiveness in facilitating learning and the students' preparedness to collaborate as a team. These two aspects are crucial for the optimal implementation of this instructional model.

Comparative Analysis with Recent Educational Research

The results of this study are consistent with the meta-analysis which found that problem-based learning approaches have a strong positive effect on critical thinking skills, with an effect size of 3.1 (Nastiti et al., 2021). However, our study extends these findings by demonstrating that the addition of structured analytic team roles and academic culture components can further enhance these effects. The progressive improvement observed across the three learning sessions in the experimental group supports the findings who noted that reflective collaborative learning models based on critical thinking require time for students to adapt to new role structures and collaborative processes (Kurniawan & Indrawati 2024). The initial challenges in time management and role allocation that improved over subsequent sessions mirror the learning curve identified in similar collaborative learning.

From a theoretical perspective, the effectiveness of the APBAC Edu model supports Vygotsky's social constructivism theory, which emphasizes the importance of social interaction in learning. The structured analytical roles (summarizer, accuracy checker, theory validator, and questioner) provide a framework for meaningful peer interaction that facilitates knowledge construction. This finding resonates with recent research who found that structured cognitive and metacognitive approaches significantly enhance critical thinking skills (Susanti, et al.., 2025). The academic culture component of the model addresses a gap identified who emphasized that academic culture encompasses collaborative norms, reflective traditions, and scholarly conventions that support students' critical learning (Tikhonova et al., 2023). Our study demonstrates how these cultural elements can be systematically integrated into learning models to enhance their effectiveness.

The practical implications of this research are significant for higher education institutions seeking to enhance 21st-century learning outcomes. The structured approach of the APBAC Edu model provides a replicable framework that can be adapted across various disciplines. This finding supports the recommendations who emphasized the need for systematic approaches to developing critical thinking skills in educational settings (Alsuwailan & Al-Shurai, 2025). The progressive improvement observed in students' ability to manage discussion time, allocate roles effectively, and engage in scientific communication suggests that the model not only enhances critical thinking but also develops essential soft skills required in the modern workplace. This multifaceted benefit aligns with the Framework for 21st Century Skills, which emphasizes the 4Cs (critical thinking, creativity, communication, and collaboration) as core competencies.

While this study demonstrates the effectiveness of the APBAC Edu model, several limitations should be acknowledged. The study was conducted in a specific context (economics education at Sriwijaya University) with a relatively short intervention period. Future research should explore the model's effectiveness across different disciplines and with longer intervention periods to assess sustainability of improvements. Additionally, the study focused primarily on quantitative measures of critical thinking skills. Future research could incorporate qualitative assessments to provide deeper insights into the mechanisms through which the model enhances learning outcomes. This recommendation aligns with recent calls for more comprehensive evaluation approaches in educational research (Putri et al., 2023).

The APBAC Edu model's emphasis on collaborative learning and authentic problem-solving aligns well with current educational trends toward student-centered learning and outcome-based education (OBE). The model's effectiveness in preparing students for 21st-century challenges supports the recommendations of the World Economic Forum (2020), which identified critical thinking as one of the top ten skills needed for future workforce success. The model's integration of academic culture components also addresses the need for developing academic integrity and scientific reasoning skills, which are increasingly important in the digital age where information literacy and critical evaluation of sources are essential competencies.

The effectiveness of the APBAC Edu model in the Indonesian educational context provides important cross-cultural validation for integrated collaborative learning approaches. Indonesian educational culture, with its emphasis on collective harmony and group collaboration, appears particularly conducive to analytic team-based learning. This cultural alignment may explain why the model achieved higher effectiveness rates (N-Gain 0.59) compared to similar studies in more individualistic educational cultures.

However, the model's effectiveness also required careful attention to Indonesian academic culture characteristics. The integration of traditional values such as respect for authority and collective decision-making with critical analytical processes required specific adaptations. For example, the "questioner" role was modified to emphasize respectful inquiry rather than direct challenge, while maintaining its critical evaluation function.

The success of the APBAC Edu model has significant implications for university education curriculum design, particularly in the context of outcome-based education (OBE) implementation. The model's structured approach provides a clear pathway for achieving critical thinking learning outcomes that are often difficult to operationalize in traditional curricula. The specific role definitions and assessment criteria developed for this study offer a replicable framework for other institutions seeking to enhance critical

thinking instruction. Furthermore, the model's integration of academic culture components addresses a critical gap in current curriculum design. Many programs focus on skills development without adequate attention to the cultural norms and practices that support sustained critical thinking. The APBAC Edu model demonstrates how academic culture can be systematically integrated into course design through specific activities and assessment practices.

While this study implemented the APBAC Edu model in traditional face-to-face settings, the structured nature of the analytic team roles makes it highly adaptable to digital learning environments. Recent research suggests that role-based collaborative learning can be effectively supported through learning management systems and collaborative platforms. The clear role definitions and structured interaction patterns of the APBAC Edu model could be enhanced through technology-mediated communication tools that support asynchronous collaboration and peer feedback. The model's emphasis on literature-based argumentation and evidence evaluation also aligns well with digital literacy competencies that are increasingly important in higher education. Future adaptations of the model could incorporate digital research skills, online source evaluation, and technology-mediated collaboration as integral components of the critical thinking development process.

While this study demonstrates the effectiveness of the APBAC Edu model, several limitations should be acknowledged for proper interpretation of the findings. First, the study was conducted in a specific disciplinary context (economics education) with particular characteristics that may not generalize to all fields. Accounting education, with its emphasis on analytical reasoning and evidence-based decision making, may be particularly conducive to the APBAC Edu approach. Second, the relatively short intervention period (three sessions) limits our understanding of the model's long-term sustainability and transfer effects. While the progressive improvement observed across sessions is encouraging, longer-term follow-up studies are needed to assess whether the critical thinking gains persist beyond the immediate intervention period. Recent research suggests that critical thinking improvements require 6-8 weeks of sustained practice to achieve stable transfer effects. Third, the study focused primarily on quantitative measures of critical thinking skills through multiple-choice assessments. While these measures provide reliable comparisons between groups, they may not capture the full complexity of critical thinking development. Future research should incorporate qualitative assessments, portfolio-based evaluations, and authentic performance tasks to provide a more comprehensive understanding of the model's impact.

Future Research Directions and Model Enhancement

The promising results of this study open several avenues for future research and model enhancement. First, longitudinal studies examining the sustained effects of the APBAC Edu model over extended periods would provide valuable insights into the durability of critical thinking improvements. Such studies should also investigate transfer effects to other courses and real-world problem-solving contexts.

Second, comparative studies across different disciplines would help identify the boundary conditions for model effectiveness. Disciplines with different epistemological foundations and reasoning patterns may require adaptations to the analytic team roles or problem-based learning components. Understanding these disciplinary variations would enhance the model's broader applicability.

Third, future research should explore the integration of the APBAC Edu model with emerging educational technologies, including artificial intelligence-supported learning analytics, virtual reality problem-solving environments, and adaptive assessment systems. These technological enhancements could provide more personalized and responsive implementations of the model.

Finally, research investigating the specific mechanisms through which the APBAC Edu model enhances critical thinking would contribute to theoretical understanding and practical optimization. Process-focused studies using think-aloud protocols, discourse analysis, and learning analytics could provide detailed insights into how the analytic team roles facilitate critical thinking development and how the model could be further refined for maximum effectiveness.

This research successfully demonstrates that the APBAC Edu model is significantly more effective than traditional Problem-Based Learning in enhancing students' critical thinking skills. The model's integration of analytic team roles, problem-based learning, and academic culture creates a comprehensive learning environment that addresses multiple dimensions of critical thinking development. The primary advantage of the APBAC Edu model lies in its structured analytical role system, which encourages active participation, in-depth analysis, and systematic evaluation of concepts. Through roles such as summarizer, accuracy checker, theory validator, and questioner, students develop not only critical thinking skills but also essential collaboration and scientific communication competencies.

From a theoretical perspective, this study contributes to the development of social constructivism theory by demonstrating how structured collaborative interactions can enhance learning outcomes. Practically, the model provides an innovative and replicable framework for educators seeking to develop 21st-century competencies in their students. The progressive improvement observed throughout the implementation process indicates that the model requires adequate time for adaptation but yields significant benefits once students become familiar with the structured approach. This finding has important implications for curriculum design and faculty development programs.

Future research should explore the model's effectiveness across different disciplines and with longer intervention periods. Additionally, the development of more contextualized assessment instruments and the integration of the model with other innovative learning approaches warrant further investigation. The APBAC Edu model represents a significant contribution to educational innovation, providing a structured and effective approach to developing critical thinking skills essential for success in the 21st century. Its implementation is recommended for courses requiring higher-order thinking skills, with appropriate support for faculty development and student orientation to maximize its effectiveness.

The primary advantage of the APBAC Edu model lies in the analytical role structure implemented within student learning teams. Through role structures such as summarizer, accuracy checker, theory validator, and questioner, students are encouraged to actively participate in every stage of the discussion. This role structure facilitates in-depth analysis, evaluation, and synthesis of concepts, enabling students to not only grasp the material superficially but also evaluate theories, assess the accuracy of information, integrate various concepts, and pose critical questions that challenge the team's understanding.

This research also successfully addressed the research question, namely the effectiveness of the APBAC Edu model in improving critical thinking skills compared to

the PBL model. The results of statistical tests show that although both models are effective in improving students' critical thinking skill, the APBAC Edu model provides a higher score increase than PBL, which indicates its effectiveness as an innovative learning model based on collaboration and structured analytical roles. This is in line with research results stating that collaborative learning using the Analytic Team technique can improve critical thinking skill through a collaborative role structure that requires analysis, evaluation, and theoretical justification in physics education students (Suryadi & Nugraha, 2024). Evidence from various studies shows that this approach is not only able to improve critical thinking skills but also strengthen cooperation and communication, which are important competencies in 21st-century learning (Nastiti et al., 2021; Hidayah et al., 2020; Yu & Zin, 2023; Kurniawan & Indrawati 2024).

Furthermore, the implementation of the APBAC Edu model to improves critical thinking skill and also fosters collaboration and scientific communication skill. In 21st-century learning, structured collaborative learning is essential to prepare students to face the complexity of global problems that require multidisciplinary team solutions. This aligns with the Framework for 21st Century Skills, which emphasizes the 4Cs as core competencies required for college graduates. Learning observations indicate that students in the experimental class demonstrated significant progress in scientific communication during discussions. Students expressed opinions not only based on their own thinking but also on scientific literature, theories, and supporting data. This demonstrates that learning using the APBAC Edu model encourages students to think critically, analytically, and engage with the literature, which are important indicators in assessing critical thinking skills.

From a practical perspective, this model is advisable for lecturers across different fields who aim to enhance their critical thinking skill in an effective and structured manner. Lecturers can modify the Analytic Team role structure according to the characteristics of the course and design authentic problems relevant to students' future professional competency needs. Furthermore, faculties can incorporate the APBAC Edu model into their innovative outcome-based education (OBE) curriculum to achieve the defined critical thinking learning outcomes.

Thus, this research makes a theoretical contribution to the development of collaborative learning and PBL theory, while also addressing a gap in previous research that has not yet examined the integration of both approaches within a unified learning model based on academic culture. Its practical contribution lies in providing an alternative, innovative learning model for lecturers and faculty in designing learning that prepares students to face the challenges of 21st-century competencies, particularly in critical thinking, teamwork, and scientific communication.

CONCLUSION

The findings of this study conclude that the implementation of the Analytic Teams Problem-Based Academic Culture Education (APBAC) Edu model is effective in enhancing students' critical thinking skills from a 21st-century perspective within the context of Economic Education at FKIP, Sriwijaya University. Specifically, the model significantly improved students' understanding of the service company accounting cycle while simultaneously fostering key academic culture values, such as honesty and responsibility. These results indicate that the APBAC Edu model successfully integrates collaborative learning with academic integrity and critical inquiry, making it particularly

well-suited for analysis- and problem-solving-based courses such as accounting, entrepreneurship, and strategic management.

Despite its demonstrated effectiveness, the study has several limitations. It was conducted within a single discipline and institutional context, which may limit the generalizability of its findings. Future research is encouraged to examine the implementation of the APBAC Edu model across diverse academic fields to assess its broader applicability. Additionally, more comprehensive and context-specific instruments for measuring critical thinking skills should be developed to suit various disciplinary needs. Lecturer training programs are also essential to ensure effective facilitation of analytic team roles. Furthermore, institutional support is necessary to strengthen academic cultures that encourage scientific dialogue and reflective thinking, making critical learning an integral part of students' academic routines.

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