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Research Article

The Combination of Learning Models (CPBL & SRL) Strengthens Critical and Creative Thinking Skills

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ABSTRACT

Introduction: In today's fast-paced, globalized world, students must develop strong critical and creative thinking abilities to succeed in the workforce and adapt to constant societal changes. These skills are essential for tackling complex problems, fostering innovation, and adjusting to new challenges. To nurture such competencies, educational strategies must not only promote independent learning but also engage students actively and encourage deep, conceptual understanding.

Objectives: This study is grounded in the perspective that integrating Collaborative Problem-Based Learning (CPBL) with Self-Regulated Learning (SRL) offers a powerful way to enhance students' higher-order thinking.

Methods: CPBL emphasizes teamwork in addressing real-life, contextual problems making the two methods complementary in fostering a thoughtful and inventive learning culture, while SRL empowers learners to manage and direct their own educational journey. Statistical analysis using the Mann-Whitney test revealed a significance level below 0.05 for both critical and creative thinking variables, indicating a meaningful difference.

Results: These results suggest that combining CPBL and SRL can be an effective approach to improving students' cognitive abilities and should be considered a valuable pedagogical option in higher education settings.

Conclusions: In conclusion, Implementing both Collaborative Problem-Based Learning (CPBL) and Self-Regulated Learning (SRL) approaches together has shown positive results in enhancing critical and creative thinking skills among students in the Informatics Study Program.

Keywords: mix model learning, collaborative problem, self regulated, critical thinking skills, creative thinking skills

INTRODUCTION

The world is undergoing a major shift with the rise of Society 4.0, marked by the growing influence of digital information and advanced technologies [1]. The foundation of life in the era of Industrial Revolution 4.0 is made up of several technologies, including data, artificial intelligence, internet networks, and information technology [2]. Then, as a result of the previous Industrial Revolution, Society 5.0 emerged (Society) [3]. This is also known as Revolutionary Industry 5.0, or Era Society 5.0. Society 5.0 refers to people who can use various innovations that emerged during the Industrial Revolution 4.0 and technological advancements to address various social issues and challenges [4]. With the advent of Era Society 5.0, Indonesia is determined to develop high-quality human capital that can address human needs by continuously analyzing information and developing new innovations to improve people's quality of life so that they can thrive in a more complex global society [5], [6]. The result is an educational strategy to develop human capital that is high-quality over time [7].

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The main human group in Indonesia that requires serious attention is the college students. College students must be encouraged to live according to the needs of the time [7]. Indonesia expects its graduates to adhere to the 21 skills [8], [9]. To navigate the challenges of the 21st century, college students need a range of essential skills. These include critical and creative thinking, effective communication, innovation, problem-solving abilities, and strong collaboration skills [10], [11]. Compared to Malay nations like Malaysia and Singapore, Indonesian students' critical and creative thinking abilities are relatively lacking . The following skills are necessary for students to overcome This is supported by an initial study carried out at Wijaya Kusuma University in Surabaya. The results of the initial study showed that 65% of students received an average score of 60. Students still struggle to apply critical and creative thinking because lecturers frequently assign difficult assignments without enough context because they lack conceptual understanding. Lecturers also have a limited amount of time and educational resources. Additionally, group projects are frequently dominated by more intelligent college students, which makes collaboration difficult, and college students have not used social media or other technologies for learning.

This is particularly pertinent to higher education in the information age we live in, where critical thinking skills are essential for efficiently processing and applying information. These skills are also critical for learning and for preparing graduates to meet demands around the world [12]. To improve critical thinking instruction methods and comprehend the elements that affect students' success in postsecondary education, more research is required [13]. Understanding problems, speculating and hypothesizing about them, identifying solutions, presenting supporting data, and finally summarizing the findings are all steps in the process of developing creative thinking skills [3] [14]. According to [15] creative thinking skills are advanced cognitive abilities that encourage the generation of novel concepts through unconventional problems [16], [17]. The ability to solve a problem using multiple approaches is another aspect of creative thinking [18] [19], [20], [21]. Therefore, we must plan the teaching process using the chosen learning model to foster critical and creative thinking in college students [16].

The study showed that the Collaborative Problem-Based Learning (CPBL) model effectively improved students' ability to think creatively and work together [22], helped children be more creative during computer play [23], and encouraged creative thinking [24]. During the Covid-19 pandemic, college students' teamwork and problem-solving skills were successfully improved by using CPBL along with online learning [25]. Prior studies have demonstrated that self-regulated learning is crucial for critical and creative thinking [26]. Students' critical and creative thinking abilities are impacted by self-regulated learning (SRL), which is made up of elements like motivation, metacognition, and the learning environment [27]. According to research, students who practice self-regulated learning are better equipped to interpret, analyze, assess, and draw conclusions during the learning process [28]. Furthermore, self-regulated learning has been discussed due to its efficacy in enhancing critical thinking abilities and other personal skills [29]. Other studies also highlight the significance of self-regulation techniques in creative learning, where teachers and students use these techniques on their own initiative to enhance the learning process [30]. Furthermore, given the close relationship between critical thinking and self-regulation, it is evident how critical thinking abilities interact with other metacognitive processes, such as self-regulated learning [31]. Students who can control their emotions are more likely to use SRL strategies successfully [32]. A number of behavioral, motivational, metacognitive, and cognitive processes are involved in SRL. Additionally, he emphasized the significance of using reliable assessment instruments to gauge SRL [33]. Students who possess strong SRL abilities can better control group dynamics and accomplish shared objectives [34]. In online learning, SRL techniques like goal-setting, time management, and self-monitoring are crucial, highlighting the necessity for teachers to offer unambiguous direction and assistance [35]. Previous studies have shown that CPBL and SRL can enhance critical and creative thinking abilities. However, the impact of combining CPBL and SRL models on students' critical and creative thinking skills and their readiness to face future academic and professional challenges has not been studied.

Based on the background above, this study has the following hypotheses:

Hypothesis 1: The combination of CPBL and SRL models improves critical thinking skills in Informatics Study Program college students.
Hypothesis 2: The combination of CPBL and SRL models improves creative thinking skills in Informatics Study Program college students.

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METHODS

Research Design & Sample

This research employs a quantitative methodology. We selected a quantitative approach to assess how much the mixed model of learning (CPBL and SRL) influences critical and creative thinking abilities. This strategy seeks to examine specific populations and samples while testing the hypothesis that has been established [36]. In order to find differences between two or more variables in a group of research subjects, the technique used is called quasi-experimental design, which is a development of the true experimental approach, which is often challenging to apply Unlike strict experimental designs that have clear control and experimental groups and use random sampling, quasi-experimental designs allow for more flexibility in looking at and understanding how variables relate to each other [37]. The Non-Equivalent Control Group is the kind of quasi-experimental design used in this study; the control and experimental groups were not chosen at random. These two groups are treated differently: the control group employs the direct instructional learning model, while the experimental group receives a mixed model of learning (collaborative problem & self-regulated). The study's sample comprised 60 students, split into 30 experimental and 30 control groups. Prior to the treatment, we administered a pretest to both groups to assess the students' baseline skills. Following treatment, a posttest was administered to both groups to evaluate any differences in outcomes.

Instrument

This research instrument used a questionnaire in the form of open-ended questions with a Likert scale. Total questions 12 (critical thinking abilities 6 and creative thinking abilities 6). All question items are analyzed for validity and reliability. Construct validity and content validity are two of the study's validity tests. By seeking expert opinion on each question item during the questionnaire's initial compilation, content validity is ensured. Construct validity was assessed using SPSS software. According to the Pearson Product Moment test, items are deemed valid if the correlation value exceeds 0.3 and the significance (p-value) is less than 0.05. Cronbach's Alpha is used in reliability tests; a value of ≥ 0.70 means that the questionnaire is sufficiently reliable to be used. Below are the findings from the questionnaire's validity and reliability tests:

Data Analysis Techniques

This study used SPSS 25 for data analysis. A descriptive statistical test was used to give an overview of the data, including the mean value, standard deviation, and number of respondents, before the analysis stage started. In addition, a normality test was performed using Shapiro-Wilk or Kolmogorov-Smirnov to guarantee a normal data distribution, which is necessary to use the t-test. To ascertain whether the variance between groups was homogeneous, a homogeneity test using Levene's Test was then employed. An independent sample t-test can be used to continue the analysis if the significance value exceeds 0.05, indicating that the data is homogeneous. The purpose of this test is to ascertain whether two independent groups differ significantly on a given variable. The SPSS output's significance value (Sig. 2-tailed) shows the test's results; if it's less than 0.05, there's a significant difference between the two groups.

RESULTS

Statistic Descriptive

Table 1. Statistic Descriptive of CRITS & CRETS

Group	N	Min	Max	Mean±Std. Deviation
CRITS Control	30	13	19	15.23±1,832
CRITS Eksperiment	30	25	30	28.73±1.413
CRETS Control	30	10	15	13.10±0.885
CRETS Eksperiment	30	24	30	27.90±1.954

Information: CRITS (critical thinking skills), CRETS (creative thinking skills)

Results of Table 1, N in each group is 30. The minimum value in the whole group is 10, and the maximum is 20. In the mean Std. Deviation results in CRITS Control 15.23±1.832, CRITS Experiment 28.73±1.413, CRETS Control 13.10±0.885, and CRETS Experiment 27.90±1.954.

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Normality and Homogeneity Test

Table 2. Normality and Homogeneity Test of CRITS & CRETS

GROUP		Shapiro-Wilk			Levene Test			
		Statistic	df	Sig.	Levene Statistic	df1	df2	Sig.
CRITS	Eksperiment	0.914	30	,019	3.254	1	58	0.076*
	Control	0.821	30	,000				
CRETS	Eksperiment	0.604	30	,000	28.824	1	58	0.000
	Control	0.871	30	,002				

Information: CRITS (critical thinking skills), CRETS (creative thinking skills), *: Normal/homogeneous

The results of table 2 show that the normality test obtained data that was not normal and not homogeneous Sig < 0.05 so that the hypothesis test must use a nonparametric test.

Hypothesis Testing

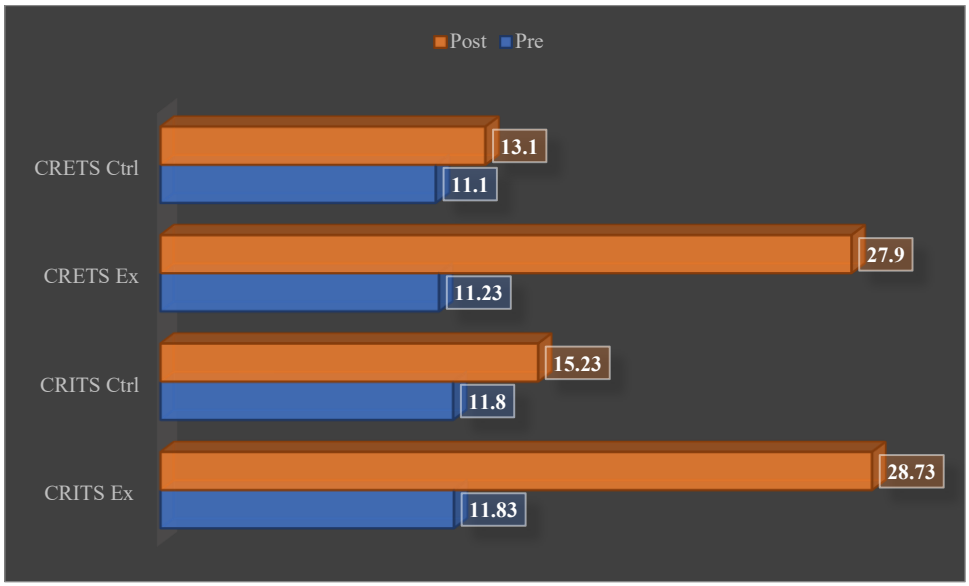
Table 3. Hypothesis Testing of CRITS & CRETS

Group	Mann-Whitney Test	Results
CRITS	0.000	Significant
CRETS	0.000	Significant

Information: CRITS (critical thinking skills), CRETS (creative thinking skills)

The findings presented in Table 3 from the Mann-Whitney Test indicate that combining CPBL and SRL learning models has a significant impact on students' critical and creative thinking abilities.

Difference between Pretest and Posttest of CRITS & CRETS



Information: (Ctrl: Control, Ex: Experiment)

Figure 1. Difference between Pretest and Posttest of CRITS & CRETS

Figure 1 shows that the increase (pre and post) between the control group and the experimental group is very far in CRITS and CRETS. The pretest results for CRETS Ctrl were 11.1 and 13.1, the pretest results for CRETS Ex were 11.23 and 27.9, the pretest results for CRITS Ctrl were 11.8 and 15.23, and the pretest results for CRITS Ex were 11.83 and 28.73. These results indicate that the experimental group showed a significant increase in CRITS & CRETS.

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DISCUSSION

The combination of the CPBL and SRL models improved critical thinking skills in college students. In line with previous research, CPBL improves critical thinking skills [38]. SRL influences critical thinking skills [39]. Because the CPBL and SRL models work in tandem to promote active participation, in-depth analysis, and logical decision-making in the learning process, they can both help students develop their critical thinking abilities. Students must methodically find, examine, and assess information as part of the real-world problem-based learning experience that CPBL offers [40]. Because students must evaluate multiple alternative solutions, challenge presumptions, and draw conclusions based on logic and evidence, this process fosters critical thinking abilities [41] . Students are required to think critically and actively to solve problems that have no clear solution when they are in problem-based learning environments [42]. However, SRL gives students the ability to control, observe, and evaluate their thought and learning processes [40]. Students who participate in SRL develop greater self-awareness, goal-setting skills, the ability to select suitable learning methods, and the capacity to independently assess the efficacy of their actions [40]. his ability is important in critical thinking because it involves metacognition, which is the ability to "think about how to think" [33]. By combining CPBL and SRL, students are taught to manage and assess their thinking in an autonomous and reflective manner in addition to having the opportunity to practice critical thinking through problem contexts. This combination of active, meaningful, and in-depth learning ultimately greatly enhances students' critical thinking abilities.

Based on the research results, it was found that the combination of the CPBL and SRL models improved creative thinking skills in college students. The findings of earlier research showing that the CPBL model enhances creative thinking skills corroborate the findings of this study [42]. Self-regulated learning is linked to the ability to think creatively, according to earlier research [43]. The combination of CPBL and SRL models can improve college students' creative thinking skills because both provide space and strategies that encourage the exploration of ideas, freedom of thought, and the development of original and innovative solutions in the learning process. CPBL places students in open and challenging problem-solving situations, which naturally encourages them to generate various alternative solutions and think flexibly [44]. This process trains students to develop their imagination, modify existing ideas, and create new approaches to a problem [42]. A learning context that emphasizes creativity in solving problems is very effective in stimulating divergent thinking, one of the main components of creative thinking [45]. Meanwhile, SRL trains students to manage their learning process independently, including how they plan, monitor, and evaluate the ideas generated [28]. Students who implement SRL tend to have high metacognitive awareness, so they are able to manage their thoughts effectively to create creative ideas, reflect on them, and improve them as needed [33]. When CPBL and SRL are combined, students are not only given stimuli that stimulate creativity through real problems but are also equipped with internal control to develop, revise, and sharpen ideas independently. The collaboration of the two encourages active, free, and reflective learning, which is ideal for optimally growing and developing creative thinking skills.

Because both CPBL and SRL have benefits that are linear with critical and creative thinking abilities, their combination impacts these abilities. Students must analyze problems, develop solutions, and test them together [45], [46] CPBL requires students to think creatively when designing solutions because they must use different perspectives and approaches from group members [47]. Groupwork in CPBL can improve students' communication skills, which are important in discussing ideas and solutions effectively [48]. CPBL encourages students to solve complex problems collaboratively, which enhances their critical thinking skills [45]. In the meantime, SRL has the following benefits: It encourages students to take charge of their learning [40]; it helps them set goals and track their progress, which enhances critical thinking and creativity; it facilitates reflection on understanding and learning strategies, which is crucial for identifying and fixing deficiencies in critical thinking processes [40],and it enables students to modify their learning strategies in response to the needs and challenges they face, supporting the development of critical and creative thinking skills [49].

By giving students a realistic and challenging environment that motivates them to collaborate to solve problems, CPBL helps students develop their critical and creative thinking abilities. Students can develop their communication and teamwork skills as well as learn from various viewpoints and solutions through group projects [50]. However, this collaboration often requires effective individual strategy adjustments, which is where SRL comes into play. SRL enables students to take charge of their education, establish objectives, track their progress, and evaluate how well their tactics are working. Students can better manage time and resources and complete group projects by honing their managerial and organizational skills [51] [52] [2]. Additionally, SRL enhances the reflection process by enabling

students to evaluate and modify their approaches in light of group experiences and feedback [53]. Students can modify their learning strategies according to their needs and challenges thanks to the partnership between CPBL and SRL, which promotes the growth of critical and creative thinking abilities [54]. As a result, CPBL and SRL integration can produce a comprehensive and encouraging learning environment that effectively fosters students' critical and creative thinking abilities.

It is important to take into account the various limitations of this study. First, the study's scope is still restricted to a single study program, so it is necessary to generalize the results to a wider context. Second, although the learning model that blends CPBL and SRL improves critical and creative thinking skills, test and observation tools are still used to measure these skills, which has limitations in capturing more contextual and complex aspects of thinking. Third, the learning model's relatively brief implementation period (one semester) probably won't be sufficient to observe the long-term effects of enhancing critical thinking abilities overall. Fourth, even though personal factors like how motivated students are, their ability to learn on their own, and how well they work with others can affect how well the CPBL and SRL models work, these factors haven't been carefully managed. Finally, this study has not used digital technology support for problem-based learning and self-directed learning management, which are vital in 21st-century education. Future research is required to investigate the application of CPBL and SRL in project-based courses, like software engineering or entrepreneurship, to determine the degree to which the combination of the two models can enhance higher-level thinking abilities, such as creativity, critical thinking, and problem-solving skills.

CONCLUSION

Implementing both Collaborative Problem-Based Learning (CPBL) and Self-Regulated Learning (SRL) approaches together has shown positive results in enhancing critical and creative thinking skills among students in the Informatics Study Program. However, since the study focused solely on students from one university's Informatics department, the results may not be fully generalizable to other disciplines or institutions with varying academic environments and student characteristics. Future studies are encouraged to implement the CPBL and SRL approach in various other disciplines such as Education, Economics, or other branches of Engineering to explore whether the model yields consistent results across diverse academic contexts.

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