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Enhancing Critical Thinking and Learning Autonomy Through the Integration of Catur Pramana Approach in Natural and Social Sciences Interactive Learning Materials

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Abstract

This research investigates the influence of integrating interactive teaching materials based on Catur pramana principles on elementary school students' critical thinking and learning autonomy in Natural and Social Sciences (IPAS). This study employed interactive learning material, critical thinking, learning autonomy, and catur pramana theories. Employing a Quasi-Experimental design with a post-test-only control group design, two Grade IV classes were selected using a statistical matching technique. Data were collected through pre- and post-tests measuring critical thinking abilities and questionnaires assessing learning autonomy. The test and questionnaire showed that the experimental group had better critical thinking and learning autonomy than the control group. Besides, the quantitative analysis using descriptive statistics and MANOVA also revealed significant effects of integrating Catur pramana-oriented interactive teaching materials on students' critical thinking and learning autonomy in IPAS subjects. This study concludes that implementing interactive teaching materials effectively improves elementary students' critical thinking and learning autonomy. The findings suggest that integrating these materials presents a promising approach to enhancing elementary school students' critical thinking and learning autonomy.

Keywords: *Catur Pramana, Critical Thinking, Learning Autonomy*

INTRODUCTION

Critical thinking is one of the most important skills to possess in the 21st century. Critical thinking helps students develop logical, creative, and innovative thinking (Murniarti et al., 2021; Nofrion & Wijayanto, 2018; Wahyudin et al., 2023). The rapid pace of development in this era is accompanied by increasingly complex problems that demand quick and precise solutions. Good logical thinking skills enable individuals to solve problems with the right solutions (Pezzuti et al., 2014). Meanwhile, creativity and innovation also help individuals make effective and efficient decisions. Therefore, it can be said that critical thinking, which can develop logical, creative, and innovative thinking skills, is highly needed in human life today.

Hence, the curriculum implemented in Indonesia also expects education in Indonesia to enhance students' critical thinking. Therefore, in the learning process, teachers in Indonesia must implement student-centred learning methods to sharpen and enhance students' critical thinking. Consequently, through the Ministry of Education, the government has recommended implementing scientific approach methods by teachers in classrooms. This scientific approach consists of several stages: observing, questioning, associating/reasoning/processing information, gathering/seeking information/trying/experimenting, and communicating. Besides enhancing critical thinking skills, the scientific approach can also help foster self-directed learning. Self-directed learning is crucial because it impacts one's lifelong learning ability.

Despite its tremendous benefits, many teachers find applying the scientific approach challenging. Some teachers feel that the scientific approach is difficult to implement in their subject teaching, especially for teachers who teach social subjects. Consequently, in reality, many teachers still only use lecture methods. Additionally, from the student's perspective, it is found that many students still face various obstacles and do not fully understand the scientific approach.

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Given the importance of the scientific approach in shaping critical thinking skills, efforts need to be made to make the scientific approach easier for both students and teachers to understand. Therefore, other simpler learning methods are needed, making it easier to understand and practical for teachers. Hence, researchers strive to develop a scientific learning method based on local wisdom concepts. The selection of local wisdom concepts is because something that has become local wisdom in a place means it has become part of the life of that community. Thus, the concept of local wisdom, in general, is already understood by the community.

Consequently, because it is already understood, applying the concept becomes easier. The local wisdom concept developed into a scientific learning method in this research is the concept of "*catur pramana* ." *Catur pramana* is four scientific methods that can be pursued to obtain true knowledge. These four methods are observation (*pratyaksa*), inference (*anumana*), comparison (*upamana*), and testimony (*sabda*).

The *catur pramana*-based learning method will be implemented in Natural and Social Sciences (IPAS) subjects. IPAS learning, a new learning that combines natural and social learning, cannot be separated from contextual learning and ends in local wisdom (BSKAP Number 033/H/KR/2022). IPAS learning emphasizes the importance of students' more independent activities in constructing knowledge, connecting it with real-life examples, and integrating science process skills with social attitudes. Specifically, the stages of the *catur pramana*-based learning method are: 1) observation stage (*pratyaksa*), where participants will first observe a phenomenon either packaged in the form of video, text, or images; 2) Reasoning stage (*anumana*), participants are expected to have initial knowledge about an IPAS material to be learned in the observation process above. In this process, participants can conclude from what they have learned; 3) Comparison stage (*upamana*), the conclusions obtained by participants are re-examined by comparing them with information from various learning sources, be it books, teachers, or other sources of information; and 4) Testimony stage (*sabda*), at this stage, students will report the results of conclusions and their analysis in front of the class, receiving confirmation or clarification from classmates and teachers. Thus, the research findings receive conclusions as concepts that can be implanted in each student's knowledge.

Furthermore, one thing that can make children interested in learning is the use of engaging learning media. Children love colourful learning media. They also enjoy illustrated stories and games. Additionally, considering that children sitting at elementary school desks today belong to the alpha generation, a generation inseparable from smartphones and the internet, they greatly appreciate interactive audio-visual learning media that can be accessed online via smartphones. Moreover, because children have different abilities, learning media appropriate to students' abilities can also increase students' learning motivation. Therefore, it can be said that by providing preferred and skill-appropriate learning media, students will be motivated to learn. Furthermore, they will study more diligently when their learning motivation is high, resulting in improved learning achievement.

Thus, this research tests interactive learning media with the *catur pramana* approach to improve students' critical thinking and self-directed learning abilities. Mastering the scientific approach will teach students to explore and acquire knowledge independently. Therefore, this research is conducted to develop interactive learning media with the *catur pramana* approach and evaluate its impact on students' critical thinking and self-directed learning.

METHOD

The research objective is to identify and discuss the influence of implementing interactive teaching materials with the *Catur Pramana* approach on students' critical thinking and self-directed learning in the IPAS subject. This research used a quasi-experimental approach and a post-test-only control group design. The study involved students from two fifth-grade classes, which, through statistical matching using one-way ANOVA, showed no significant difference in ability. One of these classes was then designated as the experimental group and the other as the control group.

Data in this study were collected using tests, which were used to measure students' critical thinking before and after the implementation of interactive teaching materials with the *Catur pramana* approach. Additionally, data were collected using a questionnaire to measure students' self-directed learning. After implementing the

interactive teaching materials with the *Catur pramana* approach, the questionnaire was administered over six sessions.

The results of the tests and questionnaires were analyzed quantitatively using descriptive statistics and MANOVA. However, before conducting the MANOVA analysis, the researcher conducted prerequisite tests, including multivariate normality tests, outliers, linearity, homogeneity of regression, and multicollinearity tests. Once the data met the requirements, they were then tested using MANOVA. To facilitate the analysis, the researcher used SPSS version 20 for Windows.

FINDINGS

The implementation of interactive teaching materials in IPAS with the *Catur pramana* approach to enhance students' critical thinking skills and self-directed learning was carried out in two schools: in the fourth-grade class of SDN 3 Banjar Jawa as the experimental group and in the fourth-grade class of SDN 1 Banjar Jawa as the control group. To determine the equivalence of students' abilities in these classes, an analysis of statistical matching was first conducted using a one-way ANOVA analysis. The results of the analysis can be seen in Table 1.

Table 1 Statistical Matching Test Results

Source	Sum of Squares	df	Mean Sum of Squares	F	Sig.
Between	270,976	10	27,098	0,692	0,732
Within	9320,358	238	39,161		
Total	9591,333	248			

The equivalence test results above indicate that the F value is 0.692 with a significance of 0.732. These results show that the significance is greater than 0.05; thus, it can be concluded that the difference in students' abilities is insignificant; in other words, both classes have equivalent abilities. Furthermore, based on the research conducted, the results of the descriptive analysis of the research data are obtained, as seen in Table 2.

Table 2 Results of Descriptive Statistics Analysis

Source	Experiment Group				Control Group			
	Pre-Test Critical Thinking	Post-Test Critical Thinking	Pre-Questionnaire Learning autonomy	Post-Questionnaire Learning autonomy	Pre-Test Critical thinking	Post-Test Critical thinking	Pre-Questionnaire Learning autonomy	Post-Questionnaire Learning autonomy
Mean	60,51	68,63	97,69	107,06	61,69	65,89	100,78	105,94
Median	61	68	97	108	61	65,5	101	107
Mode	67	74	92	112	58	67	101	105
Std, Deviation	5,89	4,65	7,28	6,78	5,11	4,43	7,24	5,98
Variance	34,73	21,65	52,99	46,00	26,10	19,59	52,41	35,77
Range	22	19	33	29	18	17	29	22
Minimum	49	56	79	86	54	57	85	92
Maximum	71	75	112	115	72	74	114	114
Sum	2118	2402	3419	3747	2221	2372	3628	3814

Based on Table 2 above, it is known that there are differences in the measurement results of critical thinking skills and self-directed learning between the experimental group and the control group. The values obtained by the experimental group for measuring critical thinking skills and self-directed learning tend to experience a higher increase compared to the control group. Therefore, to determine the significance of the difference in critical thinking skills and self-directed learning among students, the data were further analyzed using the Manova test. Before conducting the Manova test, prerequisite analyses were carried out, namely: (1) normality test of data distribution, (2) test of variance homogeneity, and (3) test of correlation between dependent variables. The results of the prerequisite tests conducted are as follows.

Normality Test Result

This study's normality test of data distribution used the Kolmogorov-Smirnov technique, which was calculated using SPSS. The results of the test are shown in Table 3 below.

Tabel 3 Normality Test Result

Variable	Kelompok	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Critical Thinking Skills	Experiment	0.088	35	0.200
	Control	0.114	36	0.200
Learning Autonomy	Experiment	0.071	35	0.200
	Control	0.165	36	0.114

Based on the normality test of data distribution above, it is found that the significance value between the data groups in this study is greater than 0.05. Referring to this test, it can be concluded that all data groups in this study are normally distributed.

Homogeneity Test Result

Homogeneity tests were conducted on the group data of students' critical thinking skills and self-directed learning collectively and individually. Collective homogeneity tests utilized the Box's M test, which was calculated with the assistance of SPSS. The results are shown in Table 4 below.

Table 4 Box'M Test Result

Box's M	5.134
F	1.658
df1	3
df2	880158.282
Sig.	0.174

Next, homogeneity tests individually were conducted using Levene's Test. Based on Levene's Test calculated with the assistance of SPSS, the results are shown in Table 5 below.

Table 5 Levene's Test

Variable	F	df1	df2	Sig.
Critical Thinking Skills	2.011	1	69	0,161
Learning Autonomy	0.465	1	69	0,498

Based on the Box's M test above, a significance value of 0.174 was obtained, while Levene's Test for the critical thinking skills variable yielded a significance value of 0.161, and for the self-directed learning variable, it was 0.498. These results indicate that the significance obtained from Box's M and Levene's tests is greater than 0.05. Thus, it can be concluded that the data in this study are homogeneous, both collectively and individually.

Correlation Test Between Dependent Variables

Correlation tests between dependent variables were conducted on the data of critical thinking skills and self-directed learning of students taught using interactive teaching materials in IPAS with the *Catur pramana* approach, as well as the data of critical thinking skills and self-directed learning of students taught using non-interactive teaching materials in IPAS with the *Catur pramana* approach. The correlation test was performed using the product-moment correlation with the assistance of SPSS at a significance level of 5%. The correlation test results using the product-moment method with the assistance of SPSS can be seen in Table 6.

Table 6 Correlation Test Between Dependent Variables Results

Sample Group	r_{xy}	N	Sig.	Conclusion
Critical thinking skills and independent learning using interactive natural and social science teaching materials with the *Catur pramana* approach	0,114	35	0,516	Not correlated
Critical thinking skills and independent learning without using interactive natural and social science teaching materials with the *Catur pramana* approach	-0,282	36	0,095	Not correlated

Based on Table 6 above, it is shown that the significance of both sample groups in the study is greater than 0.05. From these results, it can be concluded that the critical thinking skills and self-directed learning data of students who received instruction using interactive teaching materials in IPAS with the *Catur pramana* approach, as well as students who received instruction without using interactive teaching materials in IPAS with the *Catur pramana* approach, are not correlated. Therefore, hypothesis testing can proceed using Manova analysis.

Based on the Manova analysis with the assistance of SPSS, the following results were obtained:

1) There is a significant difference in the critical thinking skills of fourth-grade elementary school students in the Buleleng District between students who received instruction using interactive teaching materials in IPAS with the *Catur Pramana* approach and students who received instruction without interactive teaching materials in IPAS with the *Catur Pramana* approach, with an F value of 34.652 and a significance of 0.000.

2) There is a significant difference in the self-directed learning of fourth-grade elementary school students in the Buleleng District between students who received instruction using interactive teaching materials in IPAS with the *Catur pramana* approach and students who received instruction without interactive teaching materials in IPAS with the *Catur pramana* approach, with an F value of 21.844 and a significance of 0.000.

3) Collectively, there is a significant difference in the critical thinking skills and self-directed learning of fourth-grade elementary school students in the Buleleng District between students who received instruction using interactive teaching materials in IPAS with the *Catur pramana* approach and students who received instruction without interactive teaching materials in IPAS with the *Catur pramana* approach, with an F value of 29.409 and a significance of 0.000.

Based on the Manova analysis results above, it can be concluded that implementing interactive teaching materials in IPAS with the *Catur pramana* approach effectively enhances students' critical thinking skills and self-directed learning.

Next, to determine the effect size of the improvement in students' critical thinking skills and self-directed learning from the implementation of interactive teaching materials in IPAS with the *Catur pramana* approach, the following calculations were performed:

1) The Effect Size of students' critical thinking skills after implementing interactive teaching materials in IPAS with the *Catur Pramana* approach.

$$Es = t\ x\ \sqrt{\frac{1}{n1} + \frac{1}{n2}}$$

$$Es = 5{,}287\ x\ \sqrt{\frac{1}{35} + \frac{1}{36}}$$

$$Es = 5{,}287\ x \sqrt{0{,}029 + 0{,}028}$$

$$Es = 5{,}287\ x \sqrt{0{,}057}$$

$$Es = 5{,}287\ x\ 0{,}239$$

$$Es = 1{,}264$$

The effect Size of students' critical thinking skills from implementing interactive teaching materials in IPAS with the *Catur Pramana* approach was calculated, and a coefficient of effect size of 1.264 was obtained. Thus, it can be concluded that the effect size of students' critical thinking skills from implementing interactive teaching materials in IPAS with the *Catur Pramana* approach falls into the high category.

2) Effect size of students' self-directed learning from the implementation of interactive teaching materials in IPAS with the *Catur pramana* approach

$$Es = t\ x\ \sqrt{\frac{1}{n1} + \frac{1}{n2}}$$

$$Es = 4{,}589\ x\ \sqrt{\frac{1}{35} + \frac{1}{36}}$$

$$Es = 4{,}589\ x\sqrt{0{,}029 + 0{,}028}$$

$$Es = 4{,}589\ x\sqrt{0{,}057}$$

$$Es = 4{,}589\ x\ 0{,}239$$

$Es = 1{,}097$

The effect Size of students' self-directed learning from the implementation of interactive teaching materials in IPAS with the *Catur Pramana* approach was calculated, and a coefficient of Effect Size of 1.097 was obtained. Thus, it can be concluded that the Effect Size of students' self-directed learning from the implementation of interactive teaching materials in IPAS with the *Catur Pramana* approach falls into the high category.

DISCUSSION

From the analysis results, it was found that interactive teaching materials with the *Catur Pramana* approach significantly impact students' self-directed learning in IPAS subjects. If viewed theoretically, the success of interactive teaching materials with the *Catur pramana* approach has strength in its four stages, namely observation (*pratyaksa*), inference (*anumana*), comparison (*upamana*), and testimony (*sabda*). These four stages represent a scientific approach. Several studies have proven that observation helps students build their knowledge or enhance their understanding of the concepts being learned. The concluding stage requires students to connect the information obtained in the observation stage. Connecting this information will also be further honed in the stages of inferring and comparing. Critical thinking skills are essential at these stages. Additionally, giving testimony or conveying what is learned through presentation can train students to express opinions and build self-confidence.

In terms of self-directed learning, interactive teaching materials with the *Catur pramana* approach can enhance students' self-directed learning by choosing media they like containing pictures and videos. Children enjoy books with colourful pictures (Al-Khafaji et al., 2022; Martinez et al., 2020; J. Wang, 2020). They also enjoy short stories in videos (Kostyrka-Allchorne et al., 2019; Swider-Cios et al., 2023; Troseth & Strouse, 2017). Moreover, students like interactive teaching materials because they combine printed books with technology. Students can watch videos and take online quizzes by scanning QR codes provided in the media. Since students are part of Generation Z, they cannot be separated from their smartphones and learn better through technology (DiMattio & Hudacek, 2020; Santosa, 2017).

CONCLUSION

From the results of the study, it was found that interactive teaching materials with the *Catur pramana* approach significantly impact students' critical thinking and self-directed learning in the IPAS subject. However, considering that the sample size of this study is still limited, broader tests need to be conducted involving a larger sample size to meet the ideal number of samples. This is important to ensure that the results of this research can be generalized to a wider population. Additionally, qualitative research approaches are also needed for further studies to empirically identify the strengths possessed by interactive teaching materials with the *Catur Pramana* approach from the perspectives of both students and teachers. Therefore, further quantitative and qualitative research needs to be conducted on a larger scale.

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