Implementing Kahoot-assisted Team-Assisted Individualization (TAI) Cooperative Learning on Mathematics Problem-Solving Skills and Self-Confidence in Junior High School Students

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Abstract

This study aims to determine the effect of the Team Assisted Individualization (TAI) cooperative learning model assisted by Kahoot on students' mathematical problem-solving abilities and self-confidence. The method used is a mixed method, with an embedded model design. The research subjects were 8th-grade students at SMP Pasundan 3 Bandung. The instruments used were problem-solving ability tests and a Likert-scale self-confidence questionnaire. The results indicated that students who learned through the Kahoot-assisted TAI model experienced significantly greater improvements in mathematical problem-solving skills and self-confidence than those who received conventional instruction. These results indicate that integrating cooperative learning with a gamified digital platform can effectively enhance students' cognitive and affective learning outcomes.

Keywords: Team-Assisted Individualization (TAI), Kahoot-assisted learning, Mathematics problem-solving skills, Self-confidence, and Cooperative learning

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INTRODUCTION

Education is an essential component in developing the potential of students, both intellectually, socially, and emotionally. Referring to the Decree of the Minister of National Education Number 22 of 2006 concerning content standards, mathematics learning is designed to equip students with various important skills. According to Polya (1945), the mathematical problem-solving ability of students at the 7th-grade level is generally still in the lower-middle category .

Initial observations in grade VIII at SMP Pasundan 3 Bandung show that many students struggle with contextual problems requiring critical thinking. Few can explain their solutions systematically, while others guess without understanding. Their confidence in class is also low, indicating the need to improve problem-solving skills and confidence through active and collaborative learning.

Based on the research conducted by Schoenfeld. (2016), it was found that one of the main factors inhibiting the mathematics learning process among students is the weak mastery of prerequisite materials that should have been understood before hand. This is reinforced by Andriana et al. (2023), who developed e-learning-based teaching materials and found that although digital approaches can increase

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interest and mathematical connections, learning success still highly depends on students' mastery of basic materials. This condition causes students to experience difficulties in following advanced lessons because the knowledge foundation they possess is not yet strong enough.

In addition to a lack of mastery of prerequisite material in learning, students' lack of self-confidence is one of the factors causing low mathematical problem-solving abilities. Lubis (2019), in Hannula et al. (2004) also stated that many students still lack strong self-confidence. These results align with research by Fadillah and Ardiawan (2020) who found that self-confidence plays a significant role in the effectiveness of problem-solving learning models, as well as research by Hermaitriyana and Samsir (2021) which showed a positive relationship between self-confidence and problem-solving abilities.

To address students' low problem-solving skills and self-confidence, teachers can apply the Teams Assisted Individualization (TAI) model. According to Slavin (2014), TAI students allow to first solve problems individually, then discuss and verify answers in groups, where peers help each other understand the material thoroughly.

Interactive media is an effective way to increase student interest in learning. Fisher & Yaniawati (2021) supported technology use through a mobile-based blended model to enhance higher-order thinking. Sabandar (Islamiah, 2018) highlighted problem-solving as a key math skill, while Triana & Dwiyana (2022) found that the problem-posing approach improves problem-solving and connections when supported by engaging media like Kahoot.

Interactive media like Kahoot boosts student motivation and engagement. Zengin et al. (2012) noted that limited digital teaching design hinders deep understanding of mathematics concepts. Thus, using contextual and interactive media like Kahoot helps create more meaningful learning experiences.

This study aims to determine the effect of the Team Assisted Individualization (TAI) cooperative learning model, aided by Kahoot, on students' mathematical problem-solving abilities and self-confidence. The implementation of cooperative TAI and the use of Kahoot are expected to provide a more effective and enjoyable experience, there by achieving good learning outcomes.

Cooperative TAI Model

The TAI model is a form of cooperative learning designed to address student learning difficulties through a combination of individual and group learning. According to Slavin (2014), TAI allows students to learn independently before working in groups. Each group consists of members with heterogeneous abilities, with more capable members acting as peer tutors. Research by Tran, V. D. (2014) and Ayub (2019) show that TAI is effective in improving critical thinking skills, conceptual understanding, and learning outcomes. This learning also fosters students' sense of responsibility and social skills due to the collaborative work within the group.

Kahoot

Kahoot is a quiz-based digital learning platform that is interactive and fun. This medium allows teachers to create questions in the form of games equipped with gamification features such as scoring, leaderboards, and response times. According to Dewimarni et al. (2022), Kahoot improves student focus, accuracy, and participation during learning. Research by Juliani et al. (2023) and Wang and Tahir, (2020) found that the use of Kahoot in mathematics learning has a positive impact on student motivation and learning outcomes. In the context of cooperative learning, Kahoot can strengthen group dynamics and create a healthy competitive atmosphere.

Gamification-based learning media, such as the Kahoot used by researchers, can increase student engagement in learning both emotionally and cognitively. Wang & Tahir (2020) stated that the use of Kahoot has a significant impact on student motivation, attention, and conceptual understanding at

various educational levels. This statement aligns with Licorish et al. (2018), who stated that Kahoot can create a positive competitive atmosphere, increase participation, and strengthen knowledge retention. Kahoot functions not only as an evaluation tool but also as a learning medium to foster student interest in learning. This statement is supported by Wang (2015), who emphasized that Kahoot is not only an evaluation tool but can also be used to foster interest in learning and reduce anxiety about subjects considered difficult.

Mathematical Problem-Solving Skills

Problem-solving skills are one of the basic skills students must possess in learning mathematics. Polya in Niss, M., & Højgaard, T., (2019) proposed four systematic steps in problem-solving: understanding the problem, planning a solution, completing it, and reviewing it. Sumarmo (1994) in Maqfiroh (2019) identified indicators of problem-solving skills as the ability to identify known elements, construct mathematical models, apply strategies, explain results, and use mathematics meaningfully.

Self-confidence

Self-confidence is a person's belief in their ability to complete tasks and face challenges. Hannula et al (2002) states that self-confidence plays a crucial role in supporting students' academic success, particularly in mathematics, which requires logical and systematic thinking. According to Niss, M., & Højgaard, T., (2019), indicators of self-confidence include believing in one's own abilities, being able to make independent decisions, thinking positively, and having the courage to express opinions.

METHODS

This study used a mixed methods approach with an embedded model design. The primary method used was quantitative, supported by qualitative data through interviews and observations. The design used was a quasi-experimental study . The embedded design according to Creswell, J. W., & Creswell, J. D., (2018) is as follows.

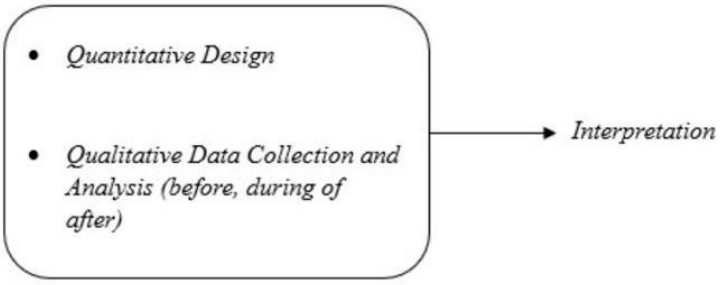

Figure 1. Embedded Model Design

The population of this study was eighth-grade students of SMP Pasundan 3 Bandung. The sample consisted of classes VIII-G (experimental) and VIII-H (control) selected purposively. This technique was used because the researcher selected the sample based on specific considerations according to the research needs. This is in line with the opinions of Creswell, J. W., & Creswell, J. D. (2018), Fraenkel, J. R., et. Al (2019), and Creswell, J. W., & Creswell, J. D., (2018), who stated that purposive sampling allows researchers to select the most relevant group to the research topic.

This research applied to the experimental class , who was given treatment in activity Study teaching using the TAI cooperative model assisted by Kahoot, and for the control class using the expository model. The following research design was used, according to Creswell, J. W., & Creswell, J. D. (2018):

O_1 X O_2

O_3 O_4

Figure.2 Research Design

Description:

O_1 dan O_2 : Prerequisite Test And Posttest experimental class

O_3 dan O_4 : Prerequisite Test and Posttest control class

X : Treatment of the TAI type cooperative learning model assisted by Kahoot

--- : Samples were not randomly assigned

RESULTS AND DISCUSSION

Mathematical Problem Solving Ability

This study assessed problem-solving skills through five descriptive questions. After six sessions, a posttest showed that students accustomed to discussion were able to organize initial information effectively, indicating a successful problem-solving strategy. This finding aligns with Widianti et al. (2024) and Charles & Lester's (2021) theory on the importance of understanding the problem context.

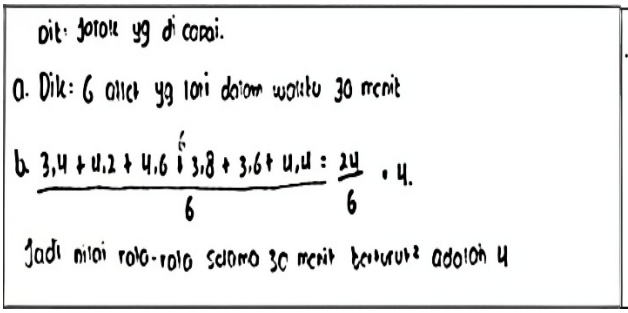

Figure 3. Answer class 1 questions control

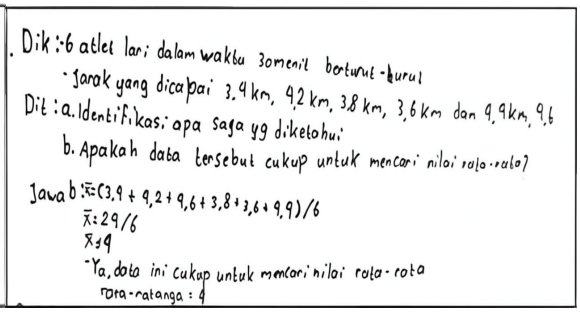

Figure 4. Answer class 1 questions experiment

Most students in the experimental class were able to complete question number 1 with a complete and systematic solution structure. This indicates that participant students understand the context of the problem and have apply it. Their answers met the initial problem-solving indicators. Meanwhile, students in the control class answered without including any known elements, thus not demonstrating an explicit thought process or coherent solution steps.

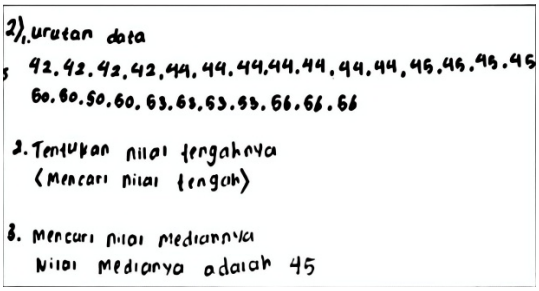

Figure 5. Answer 2nd grade questions control

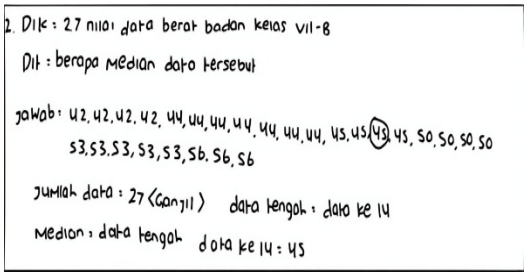

Figure 6. Answer Experimental Class Question 2

The experimental class students' answers demonstrated a systematic and explicit sequence of thinking. In contrast, the control class students immediately wrote down the steps for calculating the median without specifying what was known or what was being asked. Although their technical procedures were correct and the final median result was accurate, their thought structure was not well captured in their written answers.

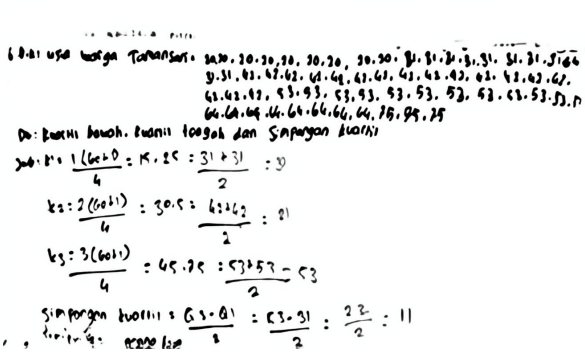

Figure 7. Answer 3rd grade questions control

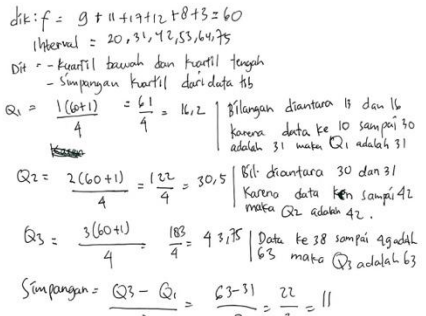

Figure 8. Answer Question 3 Experimental class

The experimental class students' answers demonstrated a high level of accuracy and systematicity. This indicates that they were able to effectively apply mathematical problem-solving strategies according to the indicators. The control class students also demonstrated good understanding, but with a different approach.

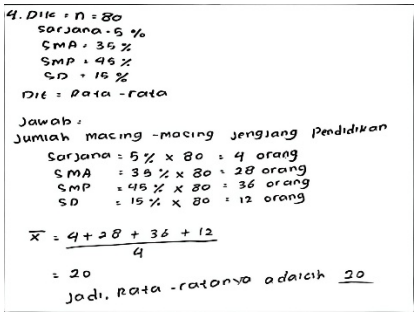

Figure 9. Answers to question 4 for the control class

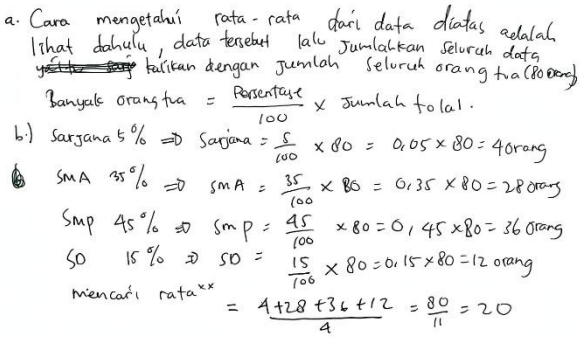

Figure 10. Answer questions for grade 4 experiment

The analysis results showed that students in the experimental class were able to read pie charts well and construct complete answers. They first explained the known parts of the diagram, then answered question 4a by stating the meaning of those parts. In question 4b, they calculated the average score

according to the context of the question and explained its relationship to the problem posed. This ability indicates that students understood the final result conceptually and were able to relate it to the initial information.

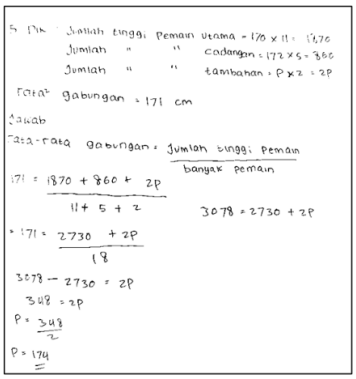

Figure 11. Answer 5th grade questions control

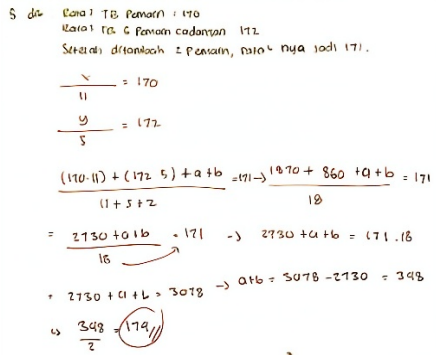

Figure 12. Answer 5th grade questions experiment

Based on the answers shown in Figure 11, students in the experimental class demonstrated uniqueness in their initial solution steps. They didn't just use the single method directly taught by the teacher, but instead tried to find alternative solutions based on their understanding of the average concept. Based on the results of the t-test analysis, it shows that one of the posttest classes received the TAI type cooperative model assisted by Kahoot and the other class received the expository learning model.

Tabel.1 Results of the Posttest Mean Test of Mathematical Problem Solving Ability

Test Condition	F	Sig. (Levene)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper
Equal variances assumed	0.111	0.740	2.818	66	0.006	6.61765	2.34806	1.92959	11.30570
Equal variances not assumed	–	–	2.818	65.744	0.006	6.61765	2.34806	1.92925	11.30604

It can be seen that the significance value of the two parties (Sig. 2-tailed) with the t-test is 0.006, so the difference in the two average data results of the posttest of mathematical problem solving ability is used with one party, through the testing criteria if 1/2the significance value is <0.05 then H_0it is rejected and H_aaccepted. Thus, the significance value obtained is smaller than 0.05, which means that the final ability in solving mathematical problems of students with the TAI type cooperative model assisted by Kahoot is better than students who receive learning through the expository model.

Research by Yaniawati et al. (2022) shows that technology-based learning and social interaction improve students' HOTS. Arifin & Ramdhani (2021) also confirmed Kahoot's effectiveness in stimulating critical thinking and strengthening mathematical concepts. The digitally assisted cooperative model helps students understand concepts more deeply and solve problems systematically. Thus, the Kahoot-assisted TAI model synergizes cognitive and affective aspects to improve learning outcomes.

Self-confidence

Self-confidence grows through active learning activities such as presentations, group discussions, and digital media use such as Kahoot. According to Dichev et al (2017), gamified learning fosters motivation and confidence through positive competition. Collaborative reflection and interactive

discussions (Rohaeti et al., 2023) also strengthen students' confidence. Based on Sociocultural Constructivism (Ningsih & Andriani, 2021), social interaction builds self-belief through peer support. Thus, the TAI cooperative model with Kahoot promotes holistic cognitive and affective development.

Table.2 The result of self confidence

Test Condition	F	Sig. (Levene)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% CI Lower	95% CI Upper
Equal variances assumed	0.330	0.568	2.032	66	0.046	4.83500	2.37897	0.08523	9.58477
Equal variances not assumed	–	–	2.032	64.767	0.047	4.83500	2.37897	0.08354	9.58646

The t-test results for the difference in means yielded a significance value of 0.046, which is less than 0.05. This indicates a statistically significant difference between the average self-confidence of students in the experimental and control classes. The difference in the average self-confidence of the two classes was 4.835. This indicates that the experimental class using the TAI cooperative model was better than the control class.

Based on results obtained researchers , can concluded that learning model cooperative Kahoot-assisted TAI type can give effect positive on ability self-confidence students . In descriptive, average score questionnaire on self-confidence in class experiment reached 78.65 (in category), whereas class control only reached 71.20 (category moderate). Increase This seen in several indicators, especially in the aspect believe to ability self alone , brave convey opinion and will for try finish question without afraid of being wrong.

This matter show that through the TAI learning model, participants educate get chance for study in a way individual at a time collaborate in group. Stages discussion and work team push participant educate For each other help and appreciate opinion, so that there is a sense of trust self they increased . When integrated with the Kahoot platform, the atmosphere Study become more Fun , competitive , and interactive . Quiz based game This give bait come back direct to answer participant educate , make they feel valued on his efforts and motivated for come on stage more good.

Findings This in line with the theory Sociocultural Constructivism (Vygotsky) which emphasizes importance interaction social in build trust self and development cognitive participant educated . In addition , research by Dichev et al (2017) states that that integration gamification like Kahoot can increase motivation intrinsic and sense of trust self through atmosphere positive competition . These results also support findings Rohaeti , et al (2023) who showed that activity discussion and presentation in group play a role important in build participants' self-confidence educate .

Correlation between Problem Solving Ability and Self-confidence

Correlation analysis aims to determine whether there is a significant relationship between self-confidence and students' problem-solving abilities.

Table.3 Correlation Test Results

Variable	Statistic	Mathematics Problem-Solving Skills	Self-Confidence
Mathematics Problem-Solving Skills	Pearson Correlation	1	0.603**
	Sig. (2-tailed)	–	0.000
	N	34	34

Self-Confidence	Pearson Correlation	0.603**	1
	Sig. (2-tailed)	0.000	–
	N	34	34

Note: Correlation is significant at the 0.01 level (2-tailed).

The analysis results show a positive and significant correlation between self-confidence and mathematical problem-solving ability, with a coefficient of 0.603 at a significance level of 0.000. This value is included in the moderate relationship category, which means that an increase in self-confidence tends to be followed by an increase in problem-solving ability. Thus, the findings suggest that the positive correlation identified in this study represents a logical connection between the development of the affective domain (self-confidence) and the attainment of cognitive abilities (mathematical problem-solving skills).

This is in accordance with research by Hermaitriyana & Samsir (2021), which showed a significant relationship between self-confidence and problem-solving ability. Yaniawati & Mubarika (2023) also confirmed that self-confidence influences cognitive achievement. Sriraman, B. (2009) added that low self-confidence and contextual experiences hinder learning achievement. Meanwhile, Setiawan et al. (2022) found that students with high motivation are better able to solve math problems logically and systematically.

The courage to participate in discussions, answer questions, and express ideas reflects self-confidence, which supports cognitive development. Martyanti (2016) stated that the TAI model provides opportunities for students to express themselves and strengthens affective aspects. The higher the self-confidence, the more courageous students are in facing mathematical challenges logically. However, according to Jusniani et al. (2018), some students still lack confidence in explaining concepts due to weak mastery of the basics and inaccurate reading of questions.

Qualitative Test Results

This research use method mixed method with embedded model design. In this study, the qualitative component served to support and enrich the quantitative findings. The qualitative data were obtained through classroom observations and interviews conducted during the learning process.

Result of method qualitative show that Participant educate in class the following experiments Kahoot- assisted TAI learning is visible more active , enthusiastic , and brave ask compared to control class ; they also showed work the same more groups good , especially in develop a resolution strategy question ; atmosphere class so more fun and interactive Because the use of Kahoot creates atmosphere healthy competitiveness ; In the interview , participants educate confess more believe self for put forward opinion because system work group give support social , and Kahoot makes they No afraid of being wrong. The result of method qualitative This can strengthen statistical test results (quantitative) which show existence improvement significant on ability solution student problems and self-confidence.

CONCLUSION

This study shows that the TAI cooperative learning model assisted by Kahoot has a positive and significant impact on junior high school students' mathematical problem-solving abilities and self-confidence . This model has been proven to create a more active, collaborative, and enjoyable learning environment. The positive impact of the Kahoot-assisted TAI learning model can be seen in the improvement of students' abilities in understanding problems, planning problem-solving strategies, and

explaining the solution steps logically and systematically. Through the individual learning phase in the TAI model, students are trained to think independently and develop their analytical skills. Furthermore, the group discussion phase (team study) allows students to exchange ideas and correct errors through social interaction. This process helps students understand concepts in depth and fosters confidence in their own abilities.

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