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EMPOWERMENT OF PROBLEM-SOLVING SKILLS THROUGH THE INVESTIGATION THROUGH COOPERATIVE PROBLEM SOLVING (ITCPS) MODEL IN LIVING OF CLASSIFICATION MATERIALS

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Abstract

Problem-solving is a thinking skill related to how students can find a solution to a problem. Problem-solving skills play an essential role in forming a person who is responsible for decisions taken and faces challenges. This study aims to determine the effect of the Investigations Through Cooperative Problem Solving (ITCPS) model on empowering problem-solving skills in the Classification of Living Things material. This study used a quasi-experimental pretest-posttest control group design. This research was conducted in semester 1 at one of Junior High School in Karanganyar. Random sampling technique to determine control class and experimental class in seventh grade students namely 7B and 7C. Data collection used a problem-solving skills test instrument and limited interviews. Analysis used independent sample t-test using SPSS software and N-Gain Score. The results showed that the ITCPS learning model affected empowering problem-solving skills with a Sig. (2-tailed) of 0.000 <0.05 and the N-Gain Score test of 53.18 (medium increase). This research implies that the ITCPS learning model with group-based problem investigation can empower problem-solving skills.

Keywords: Problem Solving Skills, Science learning, ITCPS, Classification Living Things

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INTRODUCTION

Natural Sciences is a subject that stimulates students to develop knowledge, attitudes, and skills through logical scientific activities (Kemendikbud, 2014). Science learning based on student-centred learning can increase interest in learning science (Turiman et al., 2012). The essence of science learning is to construct ideas to form thinking skills based on knowledge and experience (Riyanti et al., 2021). Students equipped with thinking skills can optimize their potential to face global challenges and the world of work in the future (Miterianifa et al., 2021).

Problem-solving skills are one of the higher-order thinking skills that need to be empowered for students (Jayadiningrat & Ati, 2018). Problem-solving skills are related to finding solutions by identifying gaps between reality and ideal conditions, hypothesizing, and planning solutions (Kwangmuang et al., 2021; Rahayu, 2022). Problem-solving skills form the basis of other 21st-century skills, so they are expected to be able to form a profile of students who can be responsible with a logical and scientific mindset as part of world citizens (Parenta et al., 2022).

Science learning demands scientific procedure-based learning, which is influenced by the skills of thinking coherently through planning and action processes which are part of problem-solving skills (Delita et al., 2020). Problem-solving skills help students know that the learning process can form participatory personalities and find meaningful learning (Anita & Bentri, 2023). Science teachers must also ensure that students are in the Zone of Proximal Development (ZPD), namely the size of students' development in learning, by providing gradual challenge activities and collaboration with friends (Bekiryazıcı, 2015).

The reality of science learning at this time is proven to be minimal empowerment of material contexts and active involvement of students so that students have difficulty as an indicator of good problem-solving skills (Fauzia & Kelana, 2020). Research conducted by Handini, Ariyanti, and Kurniawan (2023) explained that students' problem-solving skills test scores in the experimental class were 52.64 (very low) because students were rarely trained on analytical questions. The low problem-solving skills of students in science learning are caused by students not preparing for learning and not having the courage to confirm or ask questions about things that are confusing (Jua et al., 2018). Science classrooms currently only invite students to memorize theory and, while delivering the material, do not empower the context, causing narrow student participation (Patonah, 2014; Sumiantari et al., 2019).

Observations made at research schools in November 2023 showed that schools used the Independent Curriculum in teaching and learning. During the learning process, the teacher triggers students to give opinions about a natural phenomenon, but students tend to be silent and shy to express opinions. In addition, students also tend to be passive due to learning loss from the Covid-19 Pandemic, which causes students not to be used to thinking analytically (Haris et al., 2022). Limited interviews with science teachers explained that students would be active when learning outside the classroom and empowering the context. Teachers can use This potential as a material to develop and apply learning models that can support material according to student needs (Khoirurrijal et al., 2022).

Choosing a suitable learning model can improve learning outcomes and student activity (Alannasir, 2020). The learning model choice must adapt to the material being taught; for example, Classification of Living Things can be taught by implementing investigation-based material in groups (Mansur & Xaverius, 2020). Material Classification of Living Things studies categorizing and naming living things based on specific characteristics (Kurniawan & Hasanah, 2022). Research conducted by Suryani et al. (2021) explains that students are constrained by scientific naming (59.74%), understanding concepts (40.15%), and understanding terms (26.66%). The lack of variations in learning models, limited to lecture strategies and constraints in concretizing concepts, is a challenge for teachers in teaching Classification of Living Things material (Insani, 2016).

Investigation Through Cooperative Problem Solving (ITCPS) is a learning model that focuses on activities outside the classroom through a group and problem-based investigative process (Utami et al., 2021). The ITCPS model is built by integrating cooperative learning models and problem-solving (Figure 1).

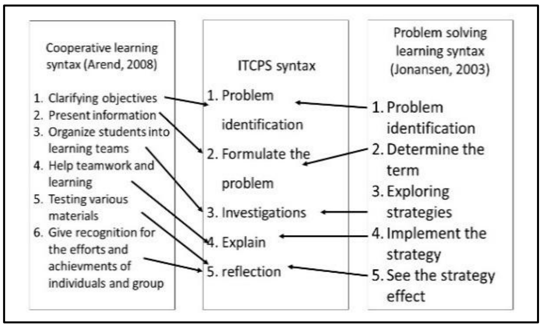

Figure 1. Construction of the ITCPS learning model

The ITCPS model consists of 5 syntaxes, namely 1) Problem identification, 2) Problem formulation, 3) Investigation, 4) Explanation, and 5) Reflection. The ITCPS learning model focuses on problems created or found, field/laboratory investigations, and group performance (Utami et al., 2021). Previous research on the ITCPS model was still limited to critical thinking skills at the high school level, specifically chemistry subjects. This model is shown to have a significant relationship with improving critical thinking skills (Utami et al., 2021). Therefore, it is necessary to develop further research to empower problem-solving skills as part of 21st-century skills. Problem-solving skills were chosen because they correlate with critical thinking skills regarding the analytical process (Cahyono, 2016).

METHOD

This study used a quasi-experimental design pretest-posttest control group. This research aims to discover how the ITCPS learning model influences the empowerment of problem-solving skills.

Research Design

Table 1. Research design pretest-posttest control groups

Class	Pretest	Treatment	Posttest
B	X1	T1	Y1
C	X2	T2	Y2

Information:
X1 and X2 = pretest
Y1 and Y2 = posttest
T1 = problem-solving model (control)
T2 = ITCPS model (experimental)

Table 1 shows that the experimental class was given the ITCPS model, while the control class used the problem-solving model. The selection of the problem-solving model in the control class aims to use a model similar to the ITCPS model.

Research Objective

The population of this study were students at one of the Junior High Schools in Karanganyar. The sampling technique used simple random sampling and obtained class B as the control class and class C as the experimental class.

Data Collection Techniques

Data retrieval using essay tests to measure problem-solving skills and limited interviews with students to add to the data description. This study uses the development of indicators of problem-solving skills owned by Mortos et al. (2004), which consist of defining problems, examining problems, planning, implementing solutions, and evaluating. Researchers asked two experts and one teacher from the research sample schools as instrument validators. After conducting the validity, it was found that ten valid questions could be used in experiments. The instrument's reliability used Cronbach's alpha with a significance of 0.716 for pretest questions and 0731 for posttest questions, which were more significant than 0.05, so the instrument was declared reliable. Data analysis used the Independent Sample T-Test and the N-Gain Score test.

RESULTS AND DISCUSSION

The ITCPS syntax was implemented three times in the Classification of Living Things chapter in the experimental class, while the control class used the problem-solving model. The test results for both classes are shown in Table 2. which explains descriptive statistics, which include the maximum, minimum, average, and standard deviation values.

Table 2. Statistical descriptive test

Statistik	Pre B	Post B	Pre C	Post C
Maximum	80	90	75	90
Minimum	40	55	25	70
Average	61,76	68,97	55,59	80,74
Standard deviation	8,39	8,98	12,35	6,97

Table 2 shows the difference in values before and after being given treatment in the control class (B) and the experimental class (C). The maximum score for both classes in the post-test results was 90, with a maximum score in the class B pre-test 80 and the class C pre-test 75. Each class experienced an average increase of 24.56 for the experimental and 9.0 for the control classes. This more significant average increase indicates differences in the effect of problem-solving skills empowered using the ITCPS model.

The independent sample t-test was used to find out the average difference in the two classes. The results of the independent sample t-test can be seen in Table 3.

Table 3. Result of the independent sample t-test

Instrument	*Sig.*	***Sig.* (*2-tailed*)**
Problem-solving skill	0,05	0,000

Based on Table 3. The value of sig. (2-tailed) of 0.000, which means it is smaller than 0.05 so that it can provide information that there is a difference in effect as seen from the difference in averages in the two classes. Regarding implementation in the field, activities in the control class were carried out individually, while the activities in the experimental class were carried out in groups. The researcher observed that students in the experimental class tended to be more courageous and not shy in expressing solutions to problems. The courage of the experimental class students was due to the space for discussion with friends, whereas in the control class, the students tended to be less active because they were still unsure of the solutions to the problems written. This is in line with the research of Mardika and Hasanah (2020) that cooperative-based activities can increase student confidence in learning.

The level of difference in the influence of the two classes can be identified by the N-Gain Score test, which can be seen in Table 4.

Table 4. N-Gain score problem-solving skill test

Class	N-Gain	Decision
Control	15.47	Low
Experiment	53.18	Medium

Table 4. shows that the overall score of the two classes' problem-solving skills tests has increased. However, the increase in the control class was only 15.47, which was classified as low, while the experimental class experienced an increase of 53.18 which was classified as moderate. The classification of the N-Gain Score test is based on Hake's research (1998) that the n-gain calculation value below 0.3 is classified as low, 0.3-0.7 is classified as medium, and above 0.7 is classified as high. The difference in the n-gain calculation is higher in the experimental class because the teacher provides additional unique worksheets designed according to the ITCPS model in the learning process.

This ITCPS model-based LKPD contains learning steps that must be carried out in groups. Even so, each child gets their LKPD to minimize the delegation of tasks to certain people. During the learning process, students are invited to identify and explore the characteristics of living things by leaving the classroom. The teacher gives worksheets based on the ITCPS model to guide observation. Students are asked to write down the formulation of the problems discussed in groups and find solutions to these problems through investigative activities outside the classroom.

Figure 2. Activities on the ITCPS model class

Limited interviews with several students provide information that activities outside the classroom are suitable for Classification of Living Things material because they can provide a direct picture of the nature of living things. Other students also provided information that group activities outside the classroom provide meaningful experiences because they can observe directly by touching, touching, and smelling the object of observation.

Good results in improving problem-solving skills are then explicitly identified for each indicator. The results of identifying each indicator can be seen in Figure 3.

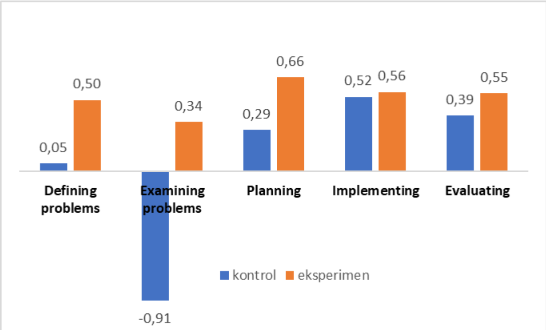

Figure 3. The n-Gain score for each

Figure 3. Shows the increase in the experimental and control classes. Every indicator of problem-solving skills has increased, except for the indicator examining problems in the control class which shows a decrease marked with a negative value (Hake, 1998).

The first indicator of problem-solving skills is defining the problem, which is influenced by the syntax of the model identifying the problem. This test form invites students to recognize the phenomenon between the roles of living things as autotrophs and heterotrophs. Analysis of pre-test answers showed that students still needed to improve in writing down the problem boundaries that were seen when students were asked about the components needed for photosynthesis, only mentioning one factor, such as water or sunlight. In addition, students also assume that humans who cook their food every day mean the same as humans produce, causing students to answer that humans are autotrophs.

Giving the ITCPS model After giving the ITCPS model and post-test, the indicator defines the problem as the highest indicator obtained from the other indicators. Students can write down the boundaries of the problem and can distinguish between autotrophs and heterotrophs. Students can understand the nature of "cooking yourself", which is processing it into food ingredients so that humans are not autotrophs.

The second indicator examines the problem, which contains an analysis of how a problem can occur and its impact. Tests on this indicator ask students to check the process of making cheese that uses the help of bacteria to classify living things. Students in the experimental class did not only write down "the number of bacteria is lacking" but also wrote down the factors related to the problem and mentioned examples of products that used the help of bacteria to associate with relevant theories.

The third indicator is planning, namely the activity of compiling solution patterns that will be implemented in the following indicator. In this indicator, students are asked to read illustrations regarding the fundamental dichotomies of several animals. Based on the results of the post-test, students can plan solutions and choose theories that support solutions, which is evidenced by students being able to make critical dichotomies between snakes, eagles, deer, and tigers. Planning is built by knowing the goals to be achieved so that they can form hypotheses. The low planning indicators follow the research of Hidayatulloh, Suyono, and Azizah (2020). The planning indicators are in the poor category, with an achievement percentage of 35% due to a lack of training in problem-solving skills.

Based on the results of observations and limited interviews with science teachers, material limitations were caused by gaps in knowledge during primary education because learning was carried out online due to the Covid-19 pandemic. A basic understanding of a material is also essential for someone to plan a solution because understanding is the basis for linking theories that will be implemented in planning (Hadi, 2019). In addition, students' accuracy in reading long questions in problem-solving skills tests makes students rush to answer (Maemanah et al., 2019).

The fourth indicator of problem-solving skills is carrying out solutions that are carried out through investigative activities and then going through the process of explaining the results obtained after the investigation. Students are given questions regarding orangutan conservation and asked to give opinions on how to carry out orangutan conservation as part of the mammalian kingdom effectively and efficiently. The results of student's answers can be seen in Figure 4.

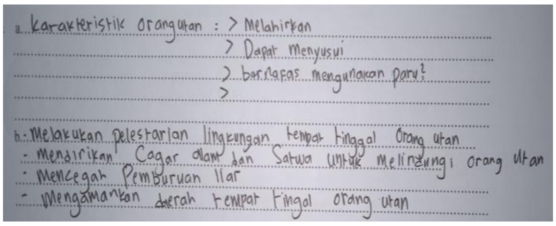

Figure 4. Answers to indicators of implementing student solutions

Figure 4 shows the various solutions given by experimental classes, such as installing fishing ban boards, conserving habitat, and keeping large trees from being cut down in the forest as the orangutan's natural habitat. This variation in answers is because students are actively stimulated to build knowledge independently in the investigation process (Sudaryati et al., 2018).

The fifth indicator is evaluating, which is correcting the solution that has been done, whether it has answered the problem or not. Based on limited interviews with students after completing the test, students explained that the illustrations on the evaluation indicator questions were lengthy, reducing the work's focus. In addition, students only focus on the conclusion of the question, so they do not re-examine parts of the text and are already satisfied with the answers written, as shown in Figure 5 (Sanjaya et al., 2014).

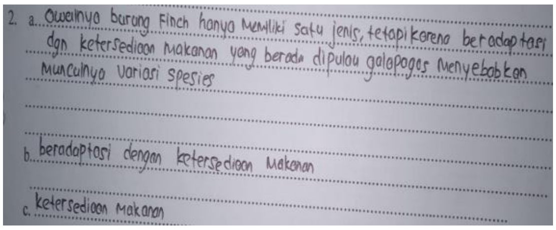

Figure 5. Answers evaluating indicators

Students can already state why there are many variations of finches on the Galapagos Islands, namely because there are variations in the availability of food. However, when students were asked to name the types of finches still alive with certain conditions, they only wrote "availability of food" even though it was implicitly mentioned in the text.

CONLUSIONS AND SUGGESTIONS

Conclusion

The Investigations Through Cooperative Problem Solving (ITCPS) learning model is proven to affect empowering problem-solving skills, as evidenced by the Asymp Sig. (2-tailed) of 0.000 so that there is an average difference between the experimental and control classes. The results of the N-Gain Score test showed that the experimental class was higher than the control class, namely 0.53 > 0.15.

Suggestion

Based on the results of the research that has been done, the researcher can formulate some suggestions for future research. Teachers should be able to profile each student in the class to find gaps in applying the ITCPS model in the learning process. Researchers can also develop more open (ill-structured) problem-solving skills instruments so they are not limited to a particular material. The investigation process can be carried out with the teacher's guidance and adapted to a particular learning topic to empower problem-solving skills. Other researchers need to pay attention to the condition of students in giving tests so that the process of working on problem-solving skills tests can take place optimally.

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