JPPIPA 10(1) (2024)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effect of Creative Problem Solving Models with Ethnoscience on Students' Problem Solving Ability and Scientific Attitudes

Rifki Nomizar Khairani[1*], A.K. Prodjosantoso[1]

[1] Department of Chemistry Education, Faculty of Science and Mathematics, Universitas Negeri Yogyakarta, Yogyakarta, Indonesia.

Received: October 18, 2024
Revised: November 27, 2024
Accepted: January 25, 2024
Published: January 31, 2024

Corresponding Author:
Rifki Nomizar Khairani
rifkinomizar.2021@student.uny.ac.id

DOI: 10.29303/jppipa.v10i1.5734

© 2024 The Authors. This open access article is distributed under a (CC-BY License)

Abstract: This research aims to analyze whether there are significant differences in problem-solving abilities and scientific attitudes between students who use the ethnoscience-based creative problem-solving learning model and students who use the Discovery learning model on colloidal materials. This research was conducted at SMA N 6 Yogyakarta and SMA N 11 Yogyakarta using a quasi-experimental method with data analysis techniques using MANOVA. Data collection techniques in this research are observation, interviews, questionnaires, and tests. The results showed that there were significant differences in problem-solving abilities and scientific attitudes between experimental class and control class students, with a significance of 0.00 < 0.05 and an effective contribution of 13.6% in the moderate category. Therefore, it can be concluded that the use of a creative problem-solving learning model based on ethnoscience has a significant influence on improving students' chemical problem-solving abilities and scientific attitudes towards colloidal materials.

Keywords: Collodial Material; Creative problem solving; Ethnoscience; Problem solving ability; Scientific Attitudes

Introduction

Education is a means of growing individual potential in society and an important element for creating human resources that are quality, intelligent, open, able to compete, and improve the welfare of the Indonesian people (Murningsih et al., 2016). Education is a bridge or alternative to develop one's potential and lead people towards a personality that is more qualified and capable of facing the current era of globalization. Education is a necessity to face the future, because without it, humans will find it very difficult to find out and develop the potential hidden within themselves. With education, students are expected to be able to improve their skills. Apart from students, teachers must also be able to be good motivators and facilitators in guiding students to achieve learning achievements. One of the skills that students and teachers must master is 21st-century education.

According Septikasari et al.(2018), in learning 21st century skills, teachers must motivate students to follow the learning process well. 21st century skills, which are usually called 4C skills (critical thinking and problem solving, communication, collaboration, and creativity and innovation), are skills that students must have in preparation for the 21st century. 21st century skills can foster and improve cooperation in a group to solve certain problems, increase tolerance towards differences in opinions of friends, and try to think critically and creatively to solve problems about connecting things. 21st century skills aim to achieve creative education by stimulating the development of creative, collaborative, problem-solving, and critical thinking abilities.

According to Rahmani et al.(2018), problem-solving abilities are very necessary for students. Learning problem-solving abilities leads students to develop thinking processes, increase concentration, and sharpen analytical skills. If students are given the opportunity to develop their ability to solve problems, they will become accustomed to distinguishing between truth and untruth, facts and opinions, as well

How to Cite:
Khairani, R. N., & Prodjosantoso, A. (2024). The Effect of Creative Problem Solving Models with Ethnoscience on Students' Problem Solving Ability and Scientific Attitudes. *Jurnal Penelitian Pendidikan IPA*, *10*(1), 360–370. https://doi.org/10.29303/jppipa.v10i1.5734

as expectations and reality. So, students are naturally able to build arguments with reliable evidence and sound logic. On the other hand, a lack of ability in problem solving will result in students having the habit of carrying out activities without knowing the purpose and reasons for doing so. Thus, it is very important for students to have problem-solving skills so that they are skilled in building arguments using reasonable logic and reliable evidence in an effort to find a solution to a problem.

The learning system in schools still focuses on what should be learned and how students should think, not on teaching how they think to solve a problem. Apart from that, learning in schools spends a lot of time teaching by only giving one correct answer and does not encourage students to expand their thinking by creating new ideas. Apart from that, learning also focuses on understanding the content of the lesson by memorizing, not on the analysis process in solving the problem. Based on the results of Moma's research (2017)on problem solving, there are still many students who are not able to solve the problems given. In general, they tend to follow the teacher's example and are unable to solve problems in their own way.

Based on research data from Arafah et al.(2016), it is known that one of the chemical materials that students consider difficult is colloidal materials. This is due to a lot of memorization, and sometimes students find it difficult to imagine the examples explained by the teacher without practice. Based on the daily test scores for colloidal chemistry, it is quite low, and half of all students are in the incomplete category. The success of the learning process is not only based on external factors but also pays attention to internal factors, one of which is a scientific attitude. Therefore, to hone the ability to solve creative problems, a scientific attitude is needed in learning.

A scientific attitude is an attitude of being able to accept other people's opinions well and correctly, acting in solving a problem systematically through scientific steps and with perseverance and openness (Ulfa, 2018). Teachers should cultivate a scientific attitude in their students. So, when they realize that the knowledge they have is still limited, curiosity will grow within them to dig up further information. Using the right learning model for the material and conditions of students can help make teaching and learning activities effective and enjoyable. In this way, students can achieve success in learning. One indicator of student success in learning is the achievement of learning outcomes that reach the Minimum Completeness Criteria (KKM).

Achieving problem-solving abilities and scientific attitudes in accordance with national education goals has also not been realized optimally. The results of interviews conducted with chemistry teachers at SMA Negeri 6 Kota Yogyakarta and SMA Negeri 11 Kota Yogyakarta show that the chemistry learning process has implemented scientific learning with a discovery learning model through discussion methods, but the problem-solving abilities and scientific attitudes of the participants are still low because only a few students dominate in learning activities. This is in line with the results of observations made by Murningsih (2016), students tend to be less brave in expressing opinions when discussing or in presentation activities. In the learning process in class, there are still students who are less interested in taking chemistry lessons. When discussing, there are those who talk to their classmates and act passively, where only one or two people express opinions.

The low achievement of problem-solving abilities and scientific attitudes is influenced by various factors, namely that education in Indonesia is still dominated by low-level cognitive achievements (Suryani et al., 2020). In fact, to develop problem-solving abilities and a scientific attitude, skills in analysis, synthesis, and evaluation are needed in an effort to solve problems that occur in everyday life. Therefore, it is necessary to apply a chemistry learning model that is appropriate to these problems. The required model must be able to facilitate students in developing abilities for solving problems and improving their scientific attitudes optimally. One model that is thought to be able to improve problem-solving abilities and scientific attitudes is the Creative Problem Solving (CPS) learning model.

The CPS learning model is a student-centered learning model, and this model is seen as effective in helping solve various problems in everyday life (Fauziah et al., 2020). Therefore, learning experiences that link learning material to everyday life can help students deepen their understanding, which is realized by carrying out ethnoscience-based learning. Ethnoscience is an approach that is able to raise people's original knowledge regarding customs and culture that can be used for learning. Learning using the ethnoscience-based CPS model seeks to link lesson content with real-world situations and motivate students to connect the knowledge they have with their daily lives, which is strengthened by increasing creativity to solve problems that will be faced later.

In solving a problem creatively, it is not enough for students to just put forward various kinds of ideas, such as only producing a number of alternative solutions to the problem. At any given time, they must also be able to decide whether to accept or reject an idea for solving a problem. In making choices, students must have relevant reasons to assess the best choice. This is where students' ability to make judgments and make decisions is trained as part of activities in problem solving and scientific attitudes. It is hoped that creative steps in solving problems can help students expand their thinking processes so that they can have a positive effect on improving problem-solving abilities and scientific attitudes.

The importance of choosing the right learning model to improve the quality of learning is very necessary in teaching. Efforts to overcome the above problems, such as difficulties in solving creative problems and scientific attitudes that are still not honed, as well as values that still do not meet the KKM, by increasing students' knowledge by teaching them through the learning process and providing varied learning models so that students can be creative and not bored in the process of solving problems or understanding learning material.

The aim of this research is to analyze whether or not there are significant differences in problem-solving abilities and scientific attitudes between experimental class students who use ethnoscience-based creative problem-solving models and control class students who use discovery learning models. The problems raised in this research are: Are there significant differences in problem-solving abilities and scientific attitudes between experimental class and control class students in learning chemistry on colloidal materials, is there a significant difference in problem-solving abilities between experimental class and control class students in learning chemistry on colloidal materials, is there a significant difference in scientific attitudes between experimental class and control class students when learning chemistry on colloidal materials and is there an effective contribution made by the ethnoscience-based Creative Problem Solving (CPS) learning model in chemistry learning towards students' problem-solving abilities and scientific attitudes towards colloidal materials.

Method

The type of research used is quasi-experimental research design. This research used 4 classes, consisting of 2 experimental classes and 2 control classes. The experimental class was treated using the ethnoscience-based CPS learning model, and the control class used the discovery learning model. The research design used a pre-test and post-test control group. The research design can be seen in Table 1.

Table 1. Research Design

Class	Initial Activity	Treatment	End Activities
Experiment	Pretest	CPS with Ethnosains	Posttest and Questionnaire
Control	Pretest	Discovery Learning	Posttest and Questionnaire

The research was carried out from April to May 2023 at SMA Negeri 6 Yogyakarta and SMA Negeri 11 Yogyakarta, even in the 2022–2023 academic year. The sample used in this research was 142 students. The experimental class consisted of 70 students, and the control class consisted of 72 students using simple random sampling techniques. Data collection instruments were questionnaire sheets and student scientific attitude observation sheets to measure students' scientific attitudes, pretest and posttest written test questions to measure students' problem-solving abilities, and a learning implementation sheet to see the extent to which learning implementation has been achieved. Learning instruments consist of RPP and LKPD. Research variables consist of problem-solving abilities and scientific attitudes. Validation is carried out theoretically and empirically. Data analysis technique using the MANOVA test.

Learning Implementation Instrument

Observation of learning implementation aims to find out the activities and process of implementing learning in the classroom, which are arranged according to the implementation scenario that has been included in the RPP. The observation sheet used in the form of a checklist consists of realizations of yes or no. The criteria for assessing learning implementation, according to Arikunto (2012), can be seen in Table 2.

Table 2. Learning Implementation Assessment Criteria

Point	Criteria
86-100	Very good
66-85	Good
46-65	Less
< 45	Very Less

Validity and Reliability of Test Instruments

Theoretical Validation

Theoretical validation was carried out to determine the suitability of the instruments used by asking chemistry learning experts for consideration by assessing the suitability of each instrument in terms of material, construction, and language. The assessment carried out by experts is qualitative. Theoretical validation includes problem-solving ability test questions, lesson plans, and student worksheets, which were carried out by two experts consisting of lecturers in the chemistry education master's department. The results of validation from experts are instruments and learning tools that are suitable for use by carrying out several revisions based on comments and suggestions from each expert.

Empirical validation

Empirical validation is used to determine whether the research instruments used are valid or not. Empirical validation is carried out by testing the test instrument outside the research sample that has studied colloidal materials. The results of the test items will later be analyzed using the Excel program and IBM SPSS statistics software version 20. Before the results of the empirical trials are tested for validity, the resulting data is first subjected to univariate and multivariate outlier tests, as well as a multivariate normality test.

The univariate outlier test is done by looking at the boxplot results, while the multivariate outlier test is done by looking at the Mahalanobis distance value. Multivariate normality test by looking at the q-q plot graph that connects Mahalanobis distance and chi square. Next, a test of the adequacy or appropriateness of a variable is carried out by looking at the value of the Kaiser Mayer-Olkin Measure of Sampling Adequacy. Data is said to be sufficient or appropriate if the KMO MSA value is > 0.7. Meanwhile, the instrument is said to be valid if the anti-image correlation result is > 0.5.

Reliability of Test Instruments

This reliability testing supports determining whether an instrument can be trusted to be used as a data collection tool or not. The criteria for interpreting the results of reliability analysis according to Hair et al. (2010) can be seen in Table 3.

Table 3. Cronbach's Alpha Reliability Level

Cronbach's Alpha	Reliability Level
0.0 – 0.20	Less reliable
> 0.20 – 0.40	Somewhat reliable
> 0.40 – 0.60	Quite reliable
> 0.60 – 0.80	Reliable
> 0.80 – 1.00	Very reliable

Effect Size

Effective contribution percentage test to determine whether or not there is a contribution made by the ethnoscience-based Creative Problem Solving (CPS) learning model to students' problem-solving abilities and scientific attitudes towards colloidal materials as seen based on partial eta squared values using the IBM SPSS statistics program version 20. Test this effect size aims to determine the size of the influence of a variable on other variables. The results of calculating the effect size value interpreted using Cohen's criteria can be seen in Table 4 below.

Table 4. Interpretation of Effect Size

Partial Eta Squared	Effect Size
0.01	Small effect
0.06	Moderate effect
0.14	Large effect

N-Gain Test

The N-Gain test is used to see how much increase in score is obtained before and after treatment. The N-Gain test, according to Hake (1999), uses the following equation:

$$\langle g \rangle = \frac{Sf - Si}{Smax - Si} \quad (1)$$

Information:
<g> : Normalized gain value
S_f : Posttest Score
S_i : Pretest Score
S_{max} : Maximum Score

The results obtained from the N-Gain test are then interpreted using the gain criteria according to Hake, which can be seen in Table 5.

Table 5. N-Gain Score Criteria

N-Gain Score	Criteria
$g > 0.7$	High
$0.3 < g \leq 0.7$	Medium
$g \leq 0.3$	Less

Resultand Discussion

The application of the ethnoscience-based Creative Problem Solving (CPS) learning model is the introduction of a new program with the idea that the learning model applied can challenge students in solving and thinking creatively to produce new understanding in the learning process. This learning model was chosen with the aim of increasing students' creative thinking while introducing Indonesian culture related to chemical materials, especially colloidal materials. The application of the ethnoscience-based CPS model was used in the experimental group, while the control group, as a comparison, used the learning model used in schools, namely the Discovery Learning learning model. Each class was held in 5 meetings, where at the first meeting a pretest of problem-solving abilities was carried out, learning treatment was carried out in 3 meetings, and at the end of the meeting there was a posttest of problem-solving abilities and filling out a scientific attitude questionnaire. At the first meeting, each class carried out a pretest to see the students' initial abilities regarding the material to be studied.

According to Adri (2020), pretests can provide students with an overview of the material to be studied so that later students' cognitive adjustments will occur to the new material. When providing treatment, each class uses a different LKPD, where the LKPD is designed according to the model applied to each class. The second meeting discussed material related to colloid systems; the third meeting discussed material on types and properties of colloids; the fourth meeting discussed material on making colloids in everyday life; and at the fifth meeting, a posttest was carried out and a scientific attitude questionnaire was filled out. According to Effendy et al.(2016), the pretest and posttest function to determine the extent of the effectiveness of learning. The results of the pretest and posttest are then compared, and it can be seen whether the teaching and learning activities and students' understanding are good or not.

Based on the results of statistical data analysis, there are significant differences in problem-solving abilities and scientific attitudes between students who use the ethnoscience-based Creative Problem Solving learning model and students who use the Discovery Learning model in learning chemistry on colloidal materials both simultaneously and individually. Problem-solving ability in this research is measured through indicators of the ability to make decisions, formulate arguments, analyze problems, draw conclusions, and reconstruct arguments. Meanwhile, indicators of a scientific attitude include curiosity, interest in learning, perseverance, and open thinking. All indicators of students' problem-solving abilities and scientific attitudes are trained through learning models applied in each class. The ethnoscience-based Creative Problem Solving (CPS) learning model and the Discovery Learning learning model provide a significant and effective contribution to the problem-solving abilities and scientific attitudes of students who are included in the moderate or moderate category. This is based on the partial eta square value, which is 0.136 or 13.6%.

Instrument Theoretical Validity Test Results

Suggestions obtained from the results of the validator review consist of two types: those accepted with revision and those accepted without revision. The validator's suggestion with the no revision category means the instrument can be used directly for field trials, while the description with revision means the item must be revised first before being used for field trials. It is hoped that suggestions from expert judgment can improve the instruments that have been developed. The involvement of expert lecturers in validity aims to obtain suggestions and input related to their area of expertise. Suggestions obtained include lesson plans, LKPD, questions, implementation sheets, observation sheets, and scientific attitude questionnaires for control classes and experiment classes. The results of the question item review are briefly presented in Table 6.

Table 6. Expert Judgment Validation Results

Expert Judgment	Question	LKPD	RPP	Questionnaire	Observation Sheet	Implementation Sheet
Validator 1	Revision	Revision	Revision	Not Revised	Revision	Not Revised
Validator 2	Revision	Revision	Revision	Not Revised	Revision	Not Revised

Description of Final Research Data

A statistical description aims to describe or provide an overview of the object being studied through a sample or population. In this study, statistical descriptions were produced using IBM SPSS Statistics version 20. A comparison of the pretest and posttest scores as well as the students' scientific attitude questionnaire between the experimental class and the control class can be seen in Table 7.

Based on the data above, the average test score for students' problem-solving abilities in the experimental class was 22.09, while in the control class it was 16.72. Thus, it can be said that the experimental class has an average value of 5.37 higher than the control class. Meanwhile, the average scientific attitude score of students in the experimental class was 83.94, while in the control class it was 78.71. Based on the results of these data, it shows that the average scientific attitude score for the experimental class is 5.23 higher than the control class. This can strengthen the test results of the Test of between Subject Effect with a significance level of 5%, which shows that there are differences in problem-solving abilities and scientific attitudes between students who use the ethnoscience-based Creative Problem Solving learning model and the control class, which uses the Discovery Learning model.

Table 7. Descriptive Statistics Test Results

Variable		Experiment	Control
	N	70	72
Problem Solving Skill			
	Mean	22.09	16.72
	Standard Deviation	7.25	6.52
Scientific Attitude			
	Mean	83.94	78.71
	Standard Deviation	14.51	14.13

In the descriptive statistics test, standard deviation values were also obtained. The standard deviation for the experimental class regarding problem-solving abilities was 7.25, and the control class obtained 6.52. Meanwhile, the standard deviation for the scientific attitude of the experimental class was 14.51 and that of the control class was 14.13; complete details are in the attachment. Based on the standard deviation values for the experimental class and control class for each of these variables, it can be seen that the results show values that are smaller than the mean value. This means that the mean value can be used as a representation of the entire dataset. Next, the data obtained from the field test results, namely in the form of problem-solving ability test scores and student scientific attitude questionnaire data, were analyzed using the help of the IBM SPSS Statistics 20 application to carry out the MANOVA test.

Hypothesis Test Results

Before testing a hypothesis using the MANOVA technique, the MANOVA assumptions or prerequisites must be tested first, which consists of nine MANOVA prerequisites that must be met. Test the first hypothesis using MANOVA; test the second and third hypotheses using the Test of Between Subject Effects test; and test the fourth, fifth, and sixth hypotheses by looking at the partial eta square value. The MANOVA test was carried out to determine whether or not there were differences in students' problem-solving abilities and scientific attitudes simultaneously between classes that used the ethnoscience-based Creative Problem Solving learning model and classes that used the Discovery Learning model.

First and Fourth Hypotheses

The first hypothesis test is to see whether or not there are significant differences in problem-solving abilities and scientific attitudes between experimental class and control class students in chemistry learning on colloidal materials, which can be seen in the MANOVA test in the Multivariate Tests table using the results of the Hotteling's Trace statistical test. This was done because there were only two independent variables, the sample size was adequate, and it met the prerequisite test for homogeneity of the variance-covariance matrix. The results of the multivariate significance test can be seen in Table 8

Table 8. Multivariate Significance Test Results

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Hotelling's Trace	.157	10.902[a]	2.000	139.000	.00	.136

Based on the results of the multivariate tests in Table 8, the results show that the significance value obtained is 0.00 < 0.05, so it can be concluded that H_0 is rejected, which means that there are significant differences in problem-solving abilities and scientific attitudes between experimental class and control class students in chemistry learning on colloidal materials. The fourth hypothesis is to determine the results of the effective contribution of the ethnoscience-based Creative Problem Solving (CPS) learning model in chemistry learning on students' problem-solving abilities and scientific attitudes towards colloidal materials. The effective contribution of the independent variable, namely using the ethnoscience-based Creative Problem Solving learning model on problem-solving abilities and scientific attitudes, can be seen from the partial eta squared value of 0.136 or 13.6%, which is included in the medium or moderate category.

According to Delita et al. (2020), problem solving has a positive effect on students' scientific skills, and these skills can be trained using problem-solving-based learning models because the syntax can train students' scientific skills. This is in line with the results of research conducted by Wijaya et al. (2018)that the high average scientific attitude is due to students carrying out learning stages that are student-centered, giving rise to a good scientific attitude, where students are oriented to problems in life, then collect information related to the problems given, and implement experimental activities to obtain explanations and solve problems.

Scientific attitudes are measured using questionnaires and observations during classroom learning activities. This observation was carried out to determine the extent of students' scientific attitudes during learning. This is in line with the results of research conducted by Alberida et al.(2018), which states that a scientific attitude is knowledge that can be obtained through observation or observations to obtain information that can be applied in everyday life, where this can be trained using learning models based on problem solving. This observation was assisted by two observers. There are four aspects observed in a scientific attitude: curiosity, interest in learning, perseverance, and open thinking. Based on the results of observations by the two observers, the average percentage of scientific attitudes in the experimental group was higher than the control class, with a difference of 0.28%. Each class shows that the curiosity aspect has the highest percentage, and the perseverance aspect shows the lowest percentage compared to the other three aspects.

According to Wahyudi (2016), students who have a high scientific attitude tend to learn more easily, receive and process information easily, and are skilled in solving problems, while students who have a low scientific attitude are less able to master lessons because of their lack of awareness facing a problem. Based on the results of the hypothesis test, it shows that the application of the ethnoscience-based Creative Problem Solving learning model can improve students' problem-solving abilities and scientific attitudes, where the effective contribution of problem-solving abilities produced is 13.3% relatively higher compared to the relatively effective contribution of scientific attitudes, namely 3.3%. Therefore, teachers must continue to develop a scientific attitude, one of which is by implementing a scientific process approach to learning. This is done so that students get used to being scientific (Arini et al., 2019).

Second, Third, Fifth and Sixth Hypotheses

The second hypothesis is to see whether or not there is a significant difference in problem-solving abilities between experimental class and control class students in chemistry learning on colloidal material, which can be seen in the MANOVA test in the Test of Between Subjects Effects table. Based on the results, a significance value of 0.00 < 0.05 was obtained, so H_0 was rejected, which means there was a significant difference in problem-solving abilities between experimental class and control class students in learning chemistry on colloidal materials. The fifth hypothesis is to determine the results of the effective contribution of the ethnoscience-based Creative Problem Solving (CPS) learning model in chemistry learning to students' problem-solving abilities in colloidal materials. The results of the effective contribution of applying the ethnoscience-based creative problem-solving learning model to problem-solving abilities are 0.133, or 13.3%, including the medium category.

The third hypothesis is to see whether or not there is a significant difference in scientific attitudes between experimental class and control class students in learning chemistry on colloidal materials, which can be seen in the MANOVA test in the Test of Between Subjects Effects table. Based on the results, a significance value of 0.03< 0.05 was obtained, so H_0 was rejected, which means there was a significant difference in scientific attitudes between experimental class and control class students in learning chemistry on colloidal materials. The sixth hypothesis is to determine the results of the effective contribution of the ethnoscience-based Creative Problem Solving (CPS) learning model in chemistry learning to students' scientific attitudes towards colloidal materials. The results of the effective contribution of applying the ethnoscience-based creative problem-solving learning model to scientific attitudes are 0.033, or 3.3%, which is in the low category. These results can be seen in Table 9 below.

Table 9. Test Results of Between Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Class	Scientific Attitude	972.516	1	972.516	4.741	.031	.033
	Problem Solving Skill	1021.028	1	1021.028	21.470	.000	.133

This is in line with the research results of Neni et al. (2021), which state that there is an influence of the creative problem-solving learning model, which is more effective than conventional learning models in improving students' abilities to solve problems. This is also supported by the research results of Munthe et al. (Munthe et al., 2023), who found that the CPS learning model influences students' creative thinking abilities. This is also supported by the results of research conducted by Rahmawati (2023), namely that there is an influence of the CPS learning model on problem-solving abilities, as seen from the significance and the fact that the average value of the problem-solving abilities of the experimental class is greater than that of the control class. Based on the results of previous research, it can be seen that by using the CPS learning model, students' problem-solving abilities can increase. According to Sumartini (2018), students' abilities can be sharpened through problems, so that students are able to improve the various competencies they have. The importance of a scientific attitude in students can help increase motivation and learning outcomes. A scientific attitude can provide an idea of how one should behave, respond to a problem, complete a task, and develop one's potential. This is in line with research conducted by Puccio et al. (2020), which states that the creative problem-solving learning model is more effective in finding and implementing ideas in groups.

This is in line with the research results of Hayati et al. (2020)that scientific attitudes have a correlation with student learning outcomes, which means that an increase in scientific attitude scores will be followed by an increase in learning outcomes scores and a decrease in scientific attitude scores will be followed by a decrease in learning outcomes scores. Previous research revealed that learning activities using the Creative Problem Solving model can develop learning motivation and improve students' scientific attitudes (Putra, 2018). This is in accordance with the research results of Utariadi et al. (2021), which state that investigative activities can improve students' research skills, where these skills are able to help students develop scientific attitudes. Previous research also states that students' active participation in scientific work can foster scientific attitudes in students (Rezkiana et al., 2023).

The small, effective contribution of scientific attitudes is influenced by several factors. The first factor that causes this low effective contribution is seen in the research period, which was carried out for one month. This very short research period was due to the delay in implementing chemistry learning, where the teacher still needed time to complete the previous chemistry material, so it took up a little time in research. Apart from that, there were several days off in the teaching schedule for research. The second factor is that in filling out the scientific attitude questionnaire, students tick without reading the filling instructions first and do not double-check the results of the questionnaire answers before collecting them because filling out the questionnaire coincides with the implementation of the posttest, so students maximize the posttest score compared to filling out the questionnaire.

Scientific attitudes can be improved by investigating according to the procedures given by the teacher and being instructional in nature, not because of the creation of the students themselves (Wildan et al., 2019). Adiansyah et al. (2021)revealed that students' scientific attitudes can be reflected in their behavior in dealing with problems consistently, rationally, and objectively. This is in line with the results of research by Juhji et al.(Juhji et al., 2020), which states that scientific attitudes must be neutralized by scientific habits themselves. This is possible because students' attitudes can change as scientific habits are implemented during the learning process. Thus, the function of time plays a role in shaping students' scientific attitudes. Through the process of habituating scientific behavior in learning, which is carried out repeatedly and continuously, this scientific attitude will be formed by itself (Arini et al., 2019).

Analysis of N-Gain Test Data Problem Solving Ability

Data collection on students' problem-solving abilities through learning in the experimental class and control class begins with pretest activities or the initial data collection process before being given treatment in the learning process. The aim is to determine the initial condition of students' problem solving abilities. After being given treatment, a final data or posttest is carried out with the aim of finding out the final condition of students' problem-solving abilities after being given treatment.

The N-Gain calculation is carried out to see the increase in students' problem-solving abilities after being given treatment based on the results of the problem-solving ability description test. The results of the analysis of the average N-Gain value of problem-solving abilities in the experimental class and control class can be seen in Table 10 below.

Table 10. N-Gain Results for Problem Solving Ability

Class	Maximum	Minimum	N-Gain	Criteria
Experiment	0.95	0.19	0.66	Medium
Control	0.93	0.14	0.48	Medium

Based on this table, it can be seen that the average increase in students' problem-solving abilities in both classes has increased. The increase in the experimental class was greater than that in the control class. The average n-gain value for the experimental class was 0.66 with medium criteria, while the n-gain control class obtained a result of 0.48 with medium criteria. The n-gain category shows the same value, but the experimental class has a higher n-gain value compared to the control class.Selection of the right learning model in the learning process can affect the increase in activity and student learning outcomes. As student activity increases, it cannot be separated from the teacher's role in teaching (Khairani et al., 2023). So, it can be seen that the increase in problem-solving abilities of students in the experimental class using the ethnoscience-based creative problem-solving learning model is higher compared to the control class.

Observation Results of Scientific Attitudes in Experimental and Control Classes

Scientific attitude observation aims to see the extent of students' scientific attitude activity during learning. This observation was assisted by two observers. There are four aspects observed in a scientific attitude: curiosity, interest in learning, perseverance, and open thinking. The indicator of the aspect of curiosity that was observed was the enthusiasm of students in asking questions, refuting, and putting forward arguments; the indicator of the aspect of interest in learning that was observed was the enthusiasm of students in responding to the teacher's questions; the indicator of the aspect of perseverance that was observed was the enthusiasm of students in completing assignments; and the indicator aspect of open thinking that was observed was accepting suggestions and input from colleagues.

Table 11. Observation Results of Scientific Attitudes of Experimental and Control Classes

Aspects of Scientific Attitude	Experiment	Control
Curiosity	7.31%	7.18%
Interest in Learning	6.74%	6.65%
Perseverance	6.52%	6.48%
Be Open Minded	6.81%	6.79%
Totals	27.38%	27.1%

The results of this scientific attitude observation were carried out to support and see the aspects of scientific attitude that were most mastered and not yet mastered by students. The results of observations of the scientific attitudes of the experimental class and control class can be seen in Table 11.

Results of Experimental and Control Class Learning Implementation

Observation of learning implementation aims to find out the activities and process of implementing learning in the classroom, which are arranged according to the implementation scenario that has been included in the RPP. The observation sheet used in the form of a checklist consists of realizations of yes or no. The results of observations of the implementation of experimental class learning can be seen in Figure 1 and the control class in Figure 2.

Based on this graph, it can be seen that there is an increase in the implementation of teacher learning activities at each meeting. Meanwhile, the implementation of student activity learning is less consistent, and there are several assessments from observers that fluctuate regarding student activity. Based on the assessment results, it can also be seen that the scores for each observer have met the very good criteria for teacher activities and the good criteria for student activities. This means that learning activities have gone well in both the experimental class and the control class.

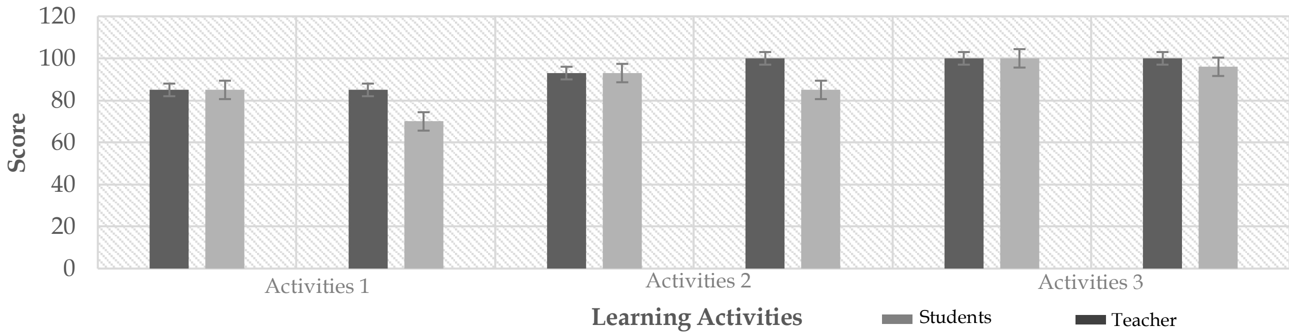

Figure 1. Graph of experimental class learning implementation results

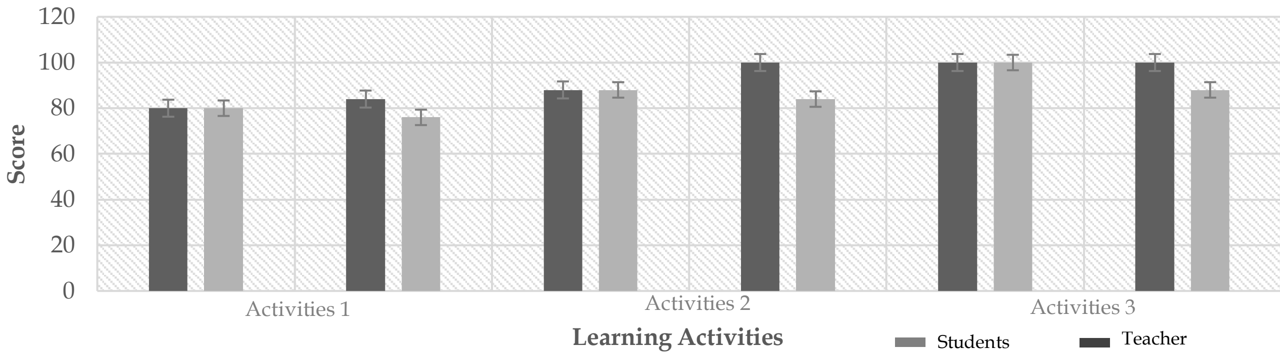

Figure 2. Graph of control class learning implementation results

Conclusion

Based on the results of research that has been carried out as well as data analysis and hypothesis testing, it can be concluded that there are significant differences in problem-solving abilities and scientific attitudes between the experimental class and the control class students, with a significance of 0.00 < 0.05 and an effective contribution of 13.6% in the medium category. Therefore, the use of a creative problem solving learning model based on ethnoscience has a significant influence on increasing students' chemical problem solving abilities and scientific attitudes towards colloidal materials.

Acknowledgments
The researcher would like to thank the chemistry teacher at SMA N 3 Yogyakarta and the students of class XI IPA 1, class XI IPA 2, class XI IPA 3, class XI IPA 4, class XI IPA 5, and class XI IPA 6. Thank you to the chemistry teacher at SMA N 6 Yogyakarta and the students of classes XI IPA 5 and XI IPA 7 as experimental and control samples, as well as the chemistry teacher at SMA N 11 Yogyakarta and the students of classes XI IPA 4 and XI IPA 5 as experimental and control samples. Thanks to all for being willing to become participants and assist with the research so that this research was carried out successfully. Don't forget to also thank your supervisor so that this journal can be published.

Author Contributions
Conceptualization, R. N. K.;methodology, R. N. K.; validation, R. N. K and A. K. P.; formal analysis, R.N. K.; investigation, R. N. K.; data curation, R. N. K.; writing original draft preparation, R. N. K.; writing review and editing, A. K. P.; visualization, R. N. K and A. K. P. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding.

Conflicts of Interest
The authors declare no conflict of interest.

References

Adiansyah, R. (2021). The correlation between metacognitive skills and scientific attitudes towards the retention of male and female students in South Sulawesi, Indonesia. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(4), 1272–1281. https://doi.org/10.11591/ijere.vl0i4.21597

Adri, R. F. (2020). Pengaruh Pre-Test Terhadap Tingkat Pemahaman Mahasiswa Program Studi Ilmu Politik Pada Mata Kuliah Ilmu Alamiah Dasar. *MENARA Ilmu*, *14*(1), 81–85. https://doi.org/10.31869/mi.v14i1.1742

Alberida, H., Lufri, Festiyed, & Barlian, E. (2018). Problem Solving Model for Science Learning. *IOP Conference Series: Materials Science and Engineering*, *335*, 012084. https://doi.org/10.1088/1757-899X/335/1/012084

Arafah, S., & Hamid, A. (2016). Meningkatkan Motivasi dan Hasil Belajar Siswa pada Materi Sistem Koloid dengan Menggunakan Model Pembelajaran Arias Bersetting Model Kooperatif Tipe Jigsaw. *Jurnal Inovasi Pendidikan Sains*, *7*(1), 83–94. https://doi.org/10.20527/quantum.v7i1.3546

Arikunto, S. (2012). *Prosedur Penelitian suatu Pendekatan Praktek*. Jakarta: Rineka Cipta.

Arini, A. N., Hartono, H., & Khumaedi, K. (2019). Analysis of Problem Solving Skills and Students Scientific Attitudes through the Implementation of Problem Based Learning Module. *Journal of Innovative Science Education*, *7*(2), 68–75. https://doi.org/10.15294/jise.v7i2.24822

Delita, R. E., Rahmadhani, F., Dezi, H., & Heffi, A. (2020). Pengaruh model problem solving terhadap keterampilan proses sains peserta didik pada materi ekskresi kelas VIII SMPN 34 Padang. *Jurnal Pendidikan Biologi*, *5*(1), 68–74. https://doi.org/10.24036/apb.v5i1.7026.g3813

Effendy, I., & Hamid, M. A. (2016). Pengaruh pemberian pretest dan posttest terhadap hasil belajar mata diklat DHW.DOV.100.2.A pada siswa SMK N2 Lubuk basung. *Jurnal Ilmiah Pendidikan Teknik Elektro*, *1*(2), 81–88. https://doi.org/10.30870/volt.v1i2.2873

Fauziah, M., Marmoah, S., Murwaningsih, T., & Saddhono, K. (2020). The effect of thinking actively in a social context and creative problem-solving learning models on divergent-thinking skills viewed from adversity quotient. *European Journal of Educational Research*, *9*(2), 537–568. https://doi.org/10.12973/eu-jer.9.2.537

Hake, R. R. (1999). *Analyzing Change/Gain Scores*. USA: Dept of Physics Indiana University.

Hayati, A. N., Joharman, J., & Suhartono, S. (2020). Hubungan antara Sikap Ilmiah dan Hasil Belajar IPA Siswa Kelas V SDN se-Kecamatan Alian Tahun Ajaran 2019/2020. *Kalam Cendekia: Jurnal Ilmiah Kependidikan*, *8*(2), 312–318. https://doi.org/10.20961/jkc.v8i2.42415

Juhji, J., & Nuangchalerm, P. (2020). Interaction between scientific attitudes and science process skills toward technological pedagogical content knowledge. *Journal for the Education of Gifted Young Scientists*, *8*(1), 1–16. https://doi.org/10.17478/jegys.600979.XX

Khairani, R. N., & Prodjosantoso, A. K. (2023).

Application of Discovery Learning Model Based on Blended Learning to Activities and Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *9*(10), 8974–8981. https://doi.org/10.29303/jppipa.v9i10.4402

Moma, L. (2017). Pengembangan Kemampuan Berpikir Kreatif Dan Pemecahan Masalah Matematis Mahasiswa Melalui Metode Diskusi. *Jurnal Cakrawala Pendidikan*, *36*(1), 130–139. https://doi.org/10.21831/cp.v36i1.10402

Munthe, S. A., Tambunan, L. O., & Sauduran, G. N. (2023). Pengaruh Model Pembelajaran Creative Problem Solving (CPS) terhadap Kemampuan Berpikir Kreatif Siswa pada Materi SPLDV di SMP Negeri 1 Panei. *Journal on Education*, *5*(2), 4426–4436. https://doi.org/10.31004/joe.v5i2.1163

Murningsih, I. M. T., Masykuri, M., & Mulyani, B. (2016). Penerapan model pembelajaran inkuiri terbimbing untuk meningkatkan sikap ilmiah dan prestasi belajar kimia siswa. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 177. https://doi.org/10.21831/jipi.v2i2.11196

Neni, N., Syaiful, S., & Maison, M. (2021). Pengaruh Model Creative Problem Solving Terhadap Kemampuan Pemecahan Masalah Matematis Ditinjau Dari Motivasi Belajar Siswa. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *10*(4), 2320. https://doi.org/10.24127/ajpm.v10i4.4143

Puccio, G. J., Burnett, C., Acar, S., Yudess, J. A., Holinger, M., & Cabra, J. F. (2020). Creative Problem Solving in Small Groups: The Effects of Creativity Training on Idea Generation, Solution Creativity, and Leadership Effectiveness. *The Journal of Creative Behavior*, *54*(2), 453–471. https://doi.org/10.1002/jocb.381

Putra, Y. P. (2018). Penggunaan model pembelajaran creative problem solving untuk meningkatkan kemampuan berpikir kreatif dan motivasi belajar matematika siswa. *Jurnal Penelitian Pendidikan Dan Pengajaran Matematika*, *4*(2), 73–80. https://doi.org/10.37058/jp3m.v4i2.605

Rahmani, W., & Widyasari, N. (2018). Meningkatkan Kemampuan Pemecahan Masalah Matematis Siswa Melalui Media Tangram. *FIBONACCI: Jurnal Pendidikan Matematika Dan Matematika*, *4*(1), 17. https://doi.org/10.24853/fbc.4.1.17-23

Rahmawati, F. (2023). Pengaruh Model Pembelajaran CPS (Creative Problem Solving) Terhadap Kemampuan Pemecahan Masalah Matematis Siswa Kelas V Sd Swasta Islam Terpadu Bandar Lampung. *INVENTA*, *7*(1), 20–26. https://doi.org/10.36456/inventa.7.1.a6988

Rezkiana, Y. R., Dewi, G. K., & Erdiana, L. (2023). Pegaruh Model Pembelajaran Creative Problem Solving Terhadap Keterampilan Berpikir Kreatif Pada Siswa Kelas V SD. *Pendas: Jurnal Ilmiah Pendidikan Dasar*, *8*(1), 4063–4074. https://doi.org/10.23969/jp.v8i1.7085

Septikasari, R., & Frasandy, R. N. (2018). Keterampilan 4C Abad 21 dalam Pembelajaran Pendidikan Dasar Resti. *Jurnal Kependidikan Islam Tingkat Dasar*, *8*(2), 107–117. https://doi.org/10.15548/alawlad.v8i2.1597

Sumartini, T. S. (2018). Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa melalui Pembelajaran Berbasis Masalah. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(2), 148–158. https://doi.org/10.31980/mosharafa.v5i2.270

Suryani, M., Jufri, L. H., & Putri, T. A. (2020). Analisis Kemampuan Pemecahan Masalah Siswa Berdasarkan Kemampuan Awal Matematika. *Mosharafa: Jurnal Pendidikan Matematika*, *9*(1), 119–130. https://doi.org/10.31980/mosharafa.v9i1.605

Ulfa, S. W. (2018). Mentradisikan Sikap Ilmiah Dalam Pembelajaran Biologi. *Jurnal Biolokus*, *1*(1), 1. https://doi.org/10.30821/biolokus.v1i1.314

Utariadi, N. K. D., Gunamantha, I. M., & Suastika, I. N. (2021). Pengembangan LKPD Berbasis Pendekatan Saintifik Untuk Meningkatkan Sikap Ilmiah Siswa Pada Tema 9 Subtema 1 Muatan Pelajaran IPA Kelas V. *Jurnal Penelitian Dan Evaluasi Pendidikan Indonesia*, *11*(2), 129–137. https://doi.org/10.23887/jpepi.v11i2.671

Wahyudi, W. (2016). Analisis Kontribusi Sikap Ilmiah, Motivasi Belajar Dan Kemandirianbelajar Terhadap Prestasi Belajar Mahasiswa Prodi Pendidikan Fisika STKIP PGRI Pontianak. *Jurnal Edukasi Matematika Dan Sains*, *1*(2), 20. https://doi.org/10.25273/jems.v1i2.123

Wijaya, S. A., Medriati, R., & Swistoro, E. (2018). Pengaruh Model Pembelajaran Berbasis Masalah terhadap Kemampuan Pemecahan Masalah Fisika dan Sikap Ilmiah Siswa di SMAN 2 Kota Bengkulu. *Jurnal Kumparan Fisika*, *1*(3), 28–35. https://doi.org/10.33369/jkf.1.3.28-35

Wildan, W., Hakim, A., Siahaan, J., & Anwar, Y. A. S. (2019). A Stepwise Inquiry Approach to Improving Communication Skills and Scientific Attitudes on a Biochemistry Course. *International Journal of Instruction*, *12*(4), 407–422. https://doi.org/10.29333/iji.2019.12427a