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The Influence of Inquiry-Based Two Stay Two Stray Strategy on Understanding the Concept of Electrolyte and Nonelectrolyte Solutions

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A B S T R A C T

This study aims to examine the effect of inquiry-based Two Stay Two Stray strategy on understanding the concept of electrolyte and nonelectrolyte solutions. The method used is a quasi-experiment with a nonequivalent control group design. The sample consisted of 52 grade X MIPA students, divided into experimental and control classes. The experimental class used the inquiry-based TSTS strategy, while the control class used the conventional method. The instrument in the form of a concept understanding test was given before and after treatment. Data analysis was carried out using an independent t-test. The results showed a significant difference between the two groups. The inquiry-based TSTS strategy is effective in improving understanding of chemical concepts and is worthy of being applied as an innovative alternative in science learning.

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INTRODUCTION

Chemistry is a branch of science that plays an important role in the development of technology and everyday life. One of the challenges in learning chemistry is its abstract nature, so students need a learning approach that is able to link theoretical concepts with concrete experiences. One of the materials that causes many misconceptions is electrolyte and nonelectrolyte solutions. This misconception often occurs because students have difficulty understanding the ionization process and the relationship between the type of solution and the ability to conduct electricity.

The reality in the field shows that chemistry learning still tends to use lecture methods and giving questions that do not actively involve students. As a result, learning becomes teacher-centered and students become passive in constructing their knowledge. This condition has the potential to reduce learning motivation and strengthen students' misconceptions about concepts that should be understood through exploration and discussion processes.

Efforts to improve chemistry learning can be done through the implementation of cooperative strategies that encourage social interaction in the learning process. One strategy that has been proven effective in improving students' learning outcomes and social skills is Two Stay Two Stray (TSTS). This strategy allows the exchange of information between groups, so that students can broaden their horizons through dialogue and reflection on the understanding of others (Elisabet, Hartoyo, & Jamiah, 2020). The discussion process in the TSTS strategy can encourage active involvement and facilitate a more meaningful understanding of concepts.

In addition to cooperative strategies, guided inquiry approaches also have great potential in chemistry learning. Guided inquiry provides space for students to discover concepts through scientific processes such as observing, formulating problems, collecting data, and drawing conclusions, but still under the direction of the teacher. This model has been proven to improve students' understanding of concepts and scientific thinking skills (Bilgin, 2009). The combination of inquiry models with cooperative strategies such as TSTS is believed to create strong synergy in discovery-based learning and collaboration.

Previous studies have shown that learning approaches that integrate cooperative and inquiry have a positive impact on understanding chemical concepts. For example, Wardani, Nurhayati, and Safitri (2016) stated that inquiry-based learning modules are effective in improving students' character and conceptual understanding. Likewise, Ramandha and Andayani (2018) found that learning with an inquiry model can significantly improve students' critical thinking skills. These findings support the use of a combination of approaches as a learning innovation in chemistry classes.

The combination of TSTS and guided inquiry strategies is expected to provide space for students to build a more active and in-depth understanding of the concept of electrolyte and nonelectrolyte solutions. Group discussions in TSTS allow for an exchange of understanding, while the inquiry approach guides students to find concepts based on real data and experiences. The integration of both is expected to enrich students' learning experiences cognitively and socially.

However, despite the documented advantages of both TSTS and guided inquiry models, there is still limited empirical evidence that specifically examines the integration of these two strategies in addressing misconceptions related to electrolyte and nonelectrolyte solutions. Most existing studies focus separately on either cooperative or inquiry learning, without analyzing the combined impact on concept comprehension in challenging chemistry topics. This lack of focused investigation represents a research gap that this study aims to address.

The main contribution of this study is to present empirical evidence on the effectiveness of integrating inquiry-based TSTS strategy in chemistry learning, especially on the topic of electrolyte and nonelectrolyte solutions. This study also expands the theoretical understanding of how social interaction and scientific exploration can be combined to improve student learning outcomes. In addition, the results of this study can be a consideration for teachers in choosing an innovative learning approach that is in accordance with the characteristics of the material. Based on this background, this study was conducted to determine the effect of inquiry-based Two Stay Two Stray strategy on the understanding of the concept of electrolyte and nonelectrolyte solutions in grade X MIPA students.

THEORETICAL REVIEW

Social Constructivism Theory

Social constructivism theory emphasizes that knowledge is built through social interactions and meaningful experiences. Vygotsky stated that the learning process becomes more effective when individuals are involved in supportive social activities, such as group discussions, collaboration, and two-way communication. In the context of cooperative learning, such as the Two Stay Two Stray strategy, students actively shape their understanding through the exchange of ideas and clarification with peers. This activity supports the formation of deeper conceptual understanding, because students not only receive information from the teacher, but also process it through dialogue and social reflection. Therefore, this strategy is very relevant to be applied in science learning that demands conceptual understanding. (Vygotsky, 1978; Slavin, 1995; Sofiyatun, Jura, & Sabang, 2021).

Inquiry Theory in Science Learning

The guided inquiry approach is rooted in Bruner's view of the importance of discovery in the learning process. Bruner emphasized that students need to be actively involved in the process of discovering knowledge through exploration, observation, and analysis. In guided inquiry, the teacher acts as a facilitator who provides a scientific framework to help students explore a concept without losing their way. This model is very suitable for application in chemistry learning, such as electrolyte and non-electrolyte solution materials, which require logical reasoning and empirical testing. With a structured inquiry process, students not only understand concepts theoretically but also experience the process of forming concepts scientifically (Purba, 2020).

Cooperative Learning with Two Stay Two Stray Strategy

The Two Stay Two Stray (TSTS) strategy is one of the effective cooperative learning techniques to improve interaction and communication between students. In this strategy, two students from each group remain in place, while the other two move to other groups to exchange information. This process creates a dynamic learning cycle and provides opportunities for students to convey and receive understanding from different perspectives. Sofiyatun et al. (2021) showed that the application of the TSTS strategy in chemistry learning can significantly improve student learning outcomes because it encourages higher cognitive and social involvement during the learning process. (Bruner, 1961; Bilgin, 2009).

Integration of TSTS Strategy with Inquiry Model

Combining the TSTS strategy with the guided inquiry model provides a double advantage in learning. TSTS strengthens the social interaction aspect, while guided inquiry provides systematic direction in exploring scientific concepts. Novianandа, Sukarianingsih, and Budiasih (2021) proved that the integration of these two approaches has a positive impact on improving the understanding of the redox concept. The synergy between group discussions and independent discovery creates a learning environment that is balanced between cooperation and structured scientific exploration.

Conceptual Learning of Electrolyte and Nonelectrolyte Solutions

The topic of electrolyte and nonelectrolyte solutions in chemistry is often a challenge for students because it is abstract and requires an understanding of microscopic phenomena such as ionization. Students' inability to connect the structure of substances and electrical conductivity leads to misconceptions. Therefore, learning strategies that involve laboratory activities and group discussions are needed. The application of inquiry-based TSTS allows students to build understanding through exploratory activities and meaningful information exchange. With this direct involvement, students are better able to form appropriate conceptual representations of the material being studied (Purba, 2020; Sofiyatun et al., 2021).

Research Hypothesis

Based on the theoretical framework and previous empirical findings, the research hypothesis is formulated as follows:

H_a: There is a significant difference in students' conceptual understanding of electrolyte and nonelectrolyte solutions between those taught using the inquiry-based Two Stay Two Stray (TSTS) strategy and those taught using conventional methods.

H_0: There is no significant difference in students' conceptual understanding of electrolyte and nonelectrolyte solutions between those taught using the inquiry-based TSTS strategy and those taught using conventional methods.

METHODOLOGY

This study uses a quantitative approach with a quasi-experimental method. The research design used is Nonequivalent Control Group Design, which involves two groups: one as an experimental class and one as a control

class. The experimental class was given treatment using the Two Stay Two Stray strategy based on inquiry, while the control class received learning with conventional methods commonly used by teachers in the classroom.

This study is theoretically grounded in **social constructivism**, **guided inquiry**, and **cooperative learning theory**, with a specific focus on the TSTS strategy. These frameworks form the basis for the instructional design applied in the experimental group. The underlying assumption is that:

1. **Social constructivism** (Vygotsky) explains how knowledge is formed through dialogue and social interaction during cooperative learning.
2. **Guided inquiry** (Bruner) emphasizes the importance of student-driven exploration within a structured scientific process.
3. The **TSTS strategy** facilitates peer interaction and reflection, which are expected to strengthen students' conceptual understanding of chemistry topics.

These theoretical perspectives are operationalized in the following research framework: **Instructional Strategy** (inquiry-based TSTS vs. conventional); **Learning Process** (exploration, collaboration, discussion); **Cognitive Outcome** (students' conceptual understanding of electrolyte and nonelectrolyte solutions)

This framework illustrates the presumed pathway from the teaching method to the learning process and finally to the measured outcome **conceptual understanding**, assessed through pre-test and post-test instruments.

The population in this study were all students of class X MIPA at SMA Negeri 17 Bone in the 2024/2025 academic year. Sampling was carried out using a purposive sampling technique, taking into account the equality of initial abilities between the experimental class and the control class. Each class consists of 26 students. The research instrument used was a conceptual understanding test in the form of multiple-choice questions that had been validated by experts. This test was given before and after treatment (pre-test and post-test) to determine the increase in students' conceptual understanding of electrolyte and non-electrolyte solutions. The test data were analyzed using descriptive and inferential statistics.

To test the hypothesis, an independent sample t-test was used through the help of SPSS software. This test aims to determine whether there is a significant difference between the conceptual understanding scores of students in the experimental class and the control class after the treatment was given. Interpretation of the test results is based on a significance level of 0.05.

RESULTS

The first step in the data collection process was carried out through a pre-test given to both groups, namely the experimental class and the control class, before the treatment was applied. The purpose of this pre-test was to determine the initial level of understanding of the concept of electrolyte and non-electrolyte solutions in each group. The results of the pre-test showed that both groups had relatively balanced initial abilities, so they were worthy of being used as comparative research subjects.

After the pre-test, the learning treatment was carried out for three meetings on the electrolyte and non-electrolyte solution material. The experimental class received learning with the Two Stay Two Stray strategy based on guided inquiry, where students were directed to discuss in groups, exchange information between groups, and conclude concepts with teacher guidance. Meanwhile, the control class continued to receive learning using conventional methods that centered on teacher explanations and individual practice questions.

The next step is to give a post-test to both groups after all treatments have been given. The post-test given uses the same instrument as the pre-test, but with a randomized question structure to avoid memorization effects. This test aims to measure students' conceptual understanding after following a learning process with a different approach.

The post-test data from both groups were then analyzed using an independent t-test with the help of the latest version of SPSS software. This test is used to determine whether there is a significant difference between the conceptual understanding scores in the experimental and control classes. Before the t-test was conducted, the data were first tested for normality and homogeneity to ensure that the basic assumptions of the statistical test were met.

Table 1. Descriptive Statistics of Post-Test Results

Descriptive Statistics	Experimental Class	Control Class
Number of Students	26	26
Average	70.42	58.62
Standard Deviation	9.49	10.91
The highest score	87.94	84.15
Lowest Value	52.63	38.56

The table above shows that the average post-test score of the experimental class is higher than that of the control class. This indicates a difference in learning outcomes after the Two Stay Two Stray inquiry-based strategy was implemented.

Table 2. Statistical Prerequisite Test Results

Statistical Test	Test Statistics	p-value	Information
Normality (Experimental Class)	0.962	0.447	Data is normally distributed
Normality (Control Class)	0.958	0.351	Data is normally distributed
Homogeneity of Variance (Levene's Test)	0.406	0.526	The variance of the two groups is homogeneous

all p values > 0.05, then the data meets the assumptions of normality and homogeneity, so it can be continued to the independent t-test.

Table 3. Independent t-Test Results

Group	*Average*	*Standard Deviation*	*t-value*	*p-value*	*Information*
Experiment	70.42	9.49	4,165	0.00013	There is a significant difference
Control	58.62	10.91			

Based on the results of the prerequisite test, the data from both groups met the requirements of normality and homogeneity. Therefore, hypothesis testing was continued using an independent t-test. The test results showed a value of t = 4.165 with p = 0.00013, which means there is a significant difference between the experimental and control classes. This shows that the inquiry-based Two Stay Two Stray strategy has a significant effect on the understanding of the concept of electrolyte and nonelectrolyte solutions.

DISCUSSION

The results of the study showed that the inquiry-based Two Stay Two Stray strategy had a significant effect on improving students' conceptual understanding of electrolyte and nonelectrolyte solutions. Students who participated in learning with this strategy showed higher conceptual mastery than those who learned using conventional methods. This finding supports the research results of Sofiyatun, Jura, and Sabang (2021) which showed that the guided inquiry approach combined with the TSTS cooperative model was able to significantly improve students' chemistry learning outcomes. The learning process involving discussions between groups and exploration of scientific phenomena creates more active and meaningful learning.

The success of the inquiry-based Two Stay Two Stray strategy is inseparable from the complementary characteristics of both. The cooperative strategy encourages active involvement of students in group discussions and exchange of ideas between members, thus creating a process of negotiation of meaning that is important in concept formation. This kind of interaction is very much in line with the principles of social constructivism, where knowledge is formed through interpersonal communication and social experiences (Effendi-Hsb & Sulistyo, 2019). When students discuss and express their opinions and receive responses, the process of internalizing knowledge occurs actively.

Meanwhile, the inquiry approach allows students to experience the scientific process through exploratory stages such as formulating questions, making observations, and drawing conclusions based on empirical evidence. According to Purba (2020), guided inquiry provides a balance between teacher direction and students' freedom of thought, allowing them to develop scientific reasoning without losing direction. This is very relevant in chemistry learning,

especially the material on electrolyte and nonelectrolyte solutions, which contains microscopic concepts such as ionization and electrical conductivity that are not easily observed directly.

A study by Novianandа, Sukarianingsih, and Budiasih (2021) showed that the combination of the Two Stay Two Stray strategy and other active learning models significantly improved students' conceptual achievement in redox reaction material, which has similar characteristics to electrolyte solutions. Likewise, a study by Wafi and Arif (2020) proved that the inquiry model was able to improve students' observation and analysis skills in the context of science learning, including abstract topics in chemistry.

The integration of cooperative strategies and inquiry approaches has also been shown to reduce student misconceptions. As stated by Rahayu, Sudarma, and Dibia (2020), the application of the TSTS model supported by visual media and experiments improves students' understanding of abstract concepts such as the role of ions in electrical conductivity. This shows that the integration of collaborative and scientific approaches is not only effective in improving student cognition but also helps in forming long-lasting conceptual understanding.

In contrast, conventional learning approaches that are still widely used in schools often only position students as recipients of information. Learning that is one-way, minimal interaction, and does not provide opportunities for independent exploration tends to produce shallow understanding. Research by Risnita and Bashori (2020) shows that traditional learning approaches produce lower learning outcomes than approaches that integrate cooperative and inquiry.

Thus, the results of this study strengthen the position of the inquiry-based Two Stay Two Stray strategy as an effective and appropriate approach to be applied to chemistry materials at the secondary school level. From a practical perspective, teachers can use this model as an innovative alternative in improving student learning outcomes. Theoretically, these findings support the validity of the theory of social constructivism and the inquiry approach in shaping students' scientific understanding through collaboration and real experiences.

CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the research that has been conducted on the influence of the Two Stay Two Stray strategy based on inquiry on the understanding of the concept of electrolyte and nonelectrolyte solutions, it can be concluded that this strategy has a significant positive impact in improving student learning outcomes. Students who learn with this strategy show higher conceptual understanding abilities compared to those who follow conventional learning. This shows that students' active involvement in the learning process through group discussions, information exchange, and scientific exploration of concepts is able to build deeper and more meaningful understanding.

The implementation of the Two Stay Two Stray strategy based on guided inquiry encourages more interactive and collaborative learning. The learning process is not only centered on the teacher, but shifts to a social process where students learn from each other, guide each other, and find common understanding. This approach has been proven to reduce misconceptions,

improve critical thinking skills, and help students understand the relationship between theory and practice in the material of electrolyte and nonelectrolyte solutions.

As a practical recommendation, teachers are advised to implement the Two Stay Two Stray inquiry-based strategy as an alternative learning method for chemistry materials that require conceptual understanding, especially abstract materials. The implementation of this strategy can be integrated into the RPP (Lesson Implementation Plan) by considering time allocation, student readiness, and available learning resources. In addition, teacher training in managing discussion and inquiry-based learning is also important to ensure the successful implementation of this strategy in the classroom.

For further research, it is suggested that this strategy be tested at other levels of education or chemistry materials to measure the consistency of its effectiveness. Further research can also combine qualitative approaches to explore more deeply the interaction process between students and group dynamics in the Two Stay Two Stray strategy. Thus, the results of the study not only provide empirical evidence, but also enrich the theoretical understanding of active and meaningful learning strategies.

FURTHER STUDY

This study has several limitations that need to be considered. First, the scope of the study only covered one school with a limited number of samples, so generalization of the results to a wider population needs to be done carefully. Second, the relatively short duration of treatment can limit observations of the long-term impact of the learning strategies used. In addition, the focus of this study only measured cognitive learning outcomes in the form of conceptual understanding, without observing the development of affective aspects and science process skills of students as a whole. Based on these limitations, it is recommended that further research be conducted with a wider scope and longer treatment duration so that the impact can be observed more comprehensively. Future research can also integrate a qualitative approach to explore the dynamics of group discussions, student learning motivation, and student responses to the inquiry-based Two Stay Two Stray strategy. In addition, the development of instruments to measure critical thinking skills and scientific attitudes can enrich the data and expand the contribution of research in the context of 21st-century chemistry learning.

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