JPPIPA 9(11) (2023)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

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

Training Students' Critical Thinking Skills Through Inquiry Models to Minimize Science Misconceptions

Julianto[1*], Fitria Hidayati[2], Julia Fatimatur Rahmawati[1], Rizka Cahyaningsih[1], Irvan Surrahman[1]

[1] Elementary School Teacher Education Study Program, Faculty of Education, Surabaya State University, Surabaya, Indonesia
[2] Elementary School Teacher Education Study Program, Faculty of Teacher Training and Education, W. R Supratman University Surabaya, Surabaya, Indonesia

Received: May 1, 2023
Revised: September 9, 2023
Accepted: November 25, 2023
Published: November 30, 2023

Corresponding Author:
Julianto
julianto@unesa.ac.id

DOI: 10.29303/jppipa.v9i11.3757

Abstract: This research was conducted using the literature review method with the aim of evaluating and integrating relevant previous research by training students' critical thinking skills through an inquiry model in order to minimize science misconceptions. The results of the literature review show that the inquiry model is one of the most effective learning models for training students' critical thinking skills and minimizing science misconceptions. The inquiry model emphasizes students' own discovery by inviting students to observe; ask; gather; and communicate their findings. Previous research also shows that training students' critical thinking skills can be done through various approaches and strategies, such as using open questions in group discussions; the use of diverse resources; and the use of technology. Besides that; Science misconceptions can be minimized by inviting students to actively participate in learning, such as providing constructive feedback and providing authentic direct experience. From the results of the literature review, we conclude that training students' critical thinking skills through inquiry models can be a solution to minimize the occurrence of science misconceptions. Therefore, implementing the inquiry model in science learning can increase students' understanding of science concepts and also improve their critical thinking skills.

Keywords: Critical Thinking; Miskonsepsi; Model Inquiry; Science Education

Introduction

Science is a branch of science that trains students to think critically and practice reasoning with consistent scientific logic (Yulianti & Zhafirah, 2020). Science learning experiences are very important for knowledge development (O'Connor et al., 2021). The aim of science learning is to be a means to train students to be able to master science concepts and principles, have scientific skills, have science process skills, and have the ability to think critically (Maharani et al., 2020). In science learning, the teacher's role is very important in balancing student-centered learning (Hansson et al., 2020). Science concepts can be incorporated by teachers into interactions with students, so as to create sustainable joint thinking. (Adbo & Vidal Carulla, 2020).

The understanding of science in schools is more at risk of misconceptions (Fridberg et al., 2019). Based on understanding science concepts, several problems that often occur are students' inability to understand science concepts (Ningrum et al., 2022). In science learning, students are often asked to imagine several phenomena (Hilppö et al., 2016). The science learning process in the classroom often experiences obstacles because students' understanding of concepts is wrong (Maison et al., 2020). Misconceptions are concepts that students do not understand because students understand only based on personal experiences and the students' own thoughts (Nurdiansyah et al., 2022). Misconceptions can occur because students understand concepts that are not in accordance with the correct concept.

Science learning is student-oriented and centered (Maharani et al., 2020). In this case, enriching students' learning experiences is the role of educators. Through various interactive activities, students can gain learning experiences together with their peers and throughout their learning environment. So that through science

How to Cite:
Julianto, Hidayati, F., Rahmawati, J. F., Cahyaningsih, R., & Surrahman, I. (2023). Training Students' Critical Thinking Skills Through Inquiry Models to Minimize Science Misconceptions. *Jurnal Penelitian Pendidikan IPA*, *9*(11), 1011–1015. https://doi.org/10.29303/jppipa.v9i11.3757

learning, students are required to be able to solve problems and find solutions in everyday life logically to minimize the occurrence of misconceptions in science learning. Natural phenomena are the basis of science learning, it would be better if science learning at school could be a forum for students to learn about themselves and their environment (Ilham et al., 2019). The surrounding environment is very influential for students because the surrounding environment can be used as a direct learning resource for students (Meiningsih, 2019).

Science learning should be able to train students' skills in active scientific attitudes and in dealing with and practicing critical thinking skills in solving problems (Devi & Bayu, 2020). Critical thinking is a skill that students must master (Encabo-Fernández et al., 2023). A mental activity to be able to formulate understanding, synthesize, and draw conclusions is an explanation of critical thinking. Critical thinking skills are something that is very important to train so that students can complete science concepts (Ramdani et al., 2020). Thinking that focuses on deciding what to do and believe is the definition of Sadirman's critical thinking ability (1996:45). Santrock (2011), explains that critical thinking is managing and transforming information in memory. Students' critical thinking skills are trained so that teachers can evaluate, and provide careful assessments regarding ideas, ideas, problems, and information that have been presented. Next, students are given time and opportunities to solve the problem and draw conclusions. The purpose of critical thinking is to test an opinion by considering thoughts based on the opinions proposed (Sapriya, 2011).

There are several learning models that are quite diverse, but the learning model that is suitable for training critical thinking skills in minimizing science misconceptions in elementary schools is the inquiry model. The inquiry process is understanding something by finding out and asking questions about something that is not yet known or not yet understood (Milanto et al., 2023). The inquiry learning model is a learning that facilitates students to ask questions and carry out searches and experiments independently according to what they need. This learning model is very influential in training students to think critically. In inquiry learning, the learning material is not given directly, so students have to search and find it themselves. (Maharani et al., 2020). The flow of inquiry learning is orientation, investigation, and conclusion (Vartiainen & Kumpulainen, 2020) According to Putra (2013), there are three types of inquiry learning models, namely guided, free, and free-modified inquiry. The inquiry model encourages students to develop conceptual models, explanations, and share ideas so that students can develop their knowledge and skills (Kaçar & Balim, 2021). In the inquiry learning model, students have a role in searching for and finding learning material themselves (Asni et al., 2020). Based on the problems mentioned above, the researcher aims to develop research that discusses students' critical thinking abilities through an inquiry learning model to minimize the occurrence of science misconceptions. So that with this research readers can understand and minimize the occurrence of misconceptions in science subjects.

Method

In this research, we used the Literature Review method. The Literature Review method is a research methodology that aims to collect and extract the essence of previous research which we then analyze in several Overviews. Researchers chose this type of method because we wanted to collect and analyze several previous studies for further research. This research uses the Systematic Literature Review method by reviewing several journals from previous research. This research is included in qualitative descriptive research. Some of the reasons researchers use a literature review research methodology are because researchers can gain a better understanding of the topic being researched. Then you can find gaps between research that still need to be researched further or have never been researched before. Apart from that, using a literature review can improve the quality of research.

Result and Discussion

Based on the results of a literature review conducted by researchers, research conducted by (Nasution et al., 2021) obtained the following results

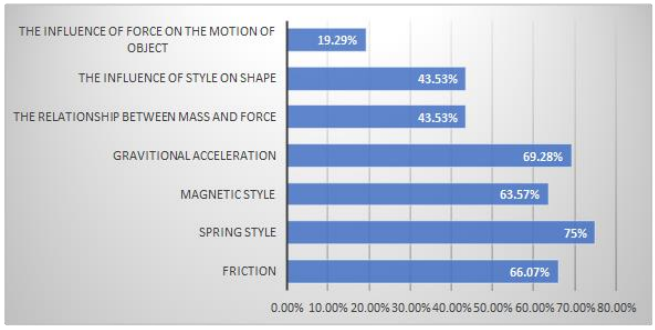

Figure 1. Percentage of SD Misconceptions for Each Sub-Indicator

It can be seen that based on the graph in Figure 1, it can be seen that there are misconceptions experienced by class V students at SDN 147 Pekanbaru. In the table, it can be seen that the lowest percentage of misconceptions

is in sub-indicator 1, namely the influence of forces on the motion of objects with a presentation of 19.29%. Meanwhile, the highest percentage of misconceptions is found in the spring force sub-indicator with a presentation of 75.00%. Thus, it can be proven that the average percentage of misconceptions among class V students at SDN 147 Pekan Baru falls into the moderate misconception category. Many class V students from SDN 147 Pekanbaru experience misconceptions when learning science about force and motion.

Furthermore, research that has been carried out (Khoirunisa et al., 2019) shows that the guided inquiry learning model can be used as an alternative learning method to reduce the level of misconceptions. According to (Wijayanti et al., 2018) misconceptions can be reduced by inviting students to search and collect data independently which can help improve critical thinking skills. In line with research that has been carried out (Khoirunisa et al., 2019; Nasution et al., 2021; Wijayanti et al., 2018) there are several things that cause misconceptions to occur among students. Misconceptions are a mismatch between the concepts understood by students and the concepts conveyed by experts. Misconceptions occur because there is a mismatch in these concepts because each student has different thoughts and experiences in everyday life so students' thoughts and reasoning are different from the concepts and thoughts of scientists (Rokhim et al., 2023).

Misconceptions are more frequent and occur without the students who experience them realizing it. A misconception is a concept that is not in accordance with experts (Suparno 2013). In general, the causes of misconceptions occur due to several things including students, teachers, textbooks, context and teaching methods (Suparno 2013). Furthermore, there are various ways that can be used to identify the occurrence of misconceptions, including making concept maps, giving multiple choice tests and essays, conducting interviews and discussions Suparno (2013). In order to minimize the occurrence of student misconceptions in elementary schools, students should be actively involved in science learning in elementary schools. In this way, students are expected to be able to understand science learning concepts better than just listening to the teacher's explanation through conventional methods such as lectures. In scientific learning, learning using the lecture method has the potential to cause misconceptions in students. Misunderstandings that last a long time and cannot be repeated will be stable misunderstandings and will be difficult to correct, so they can cause obstacles from the scientific perspective (Halim et al., 2018).

The selection of learning models and methods is very important in minimizing the occurrence of misconceptions in science learning (Dewi & Ibrahim, 2019). Through the inquiry learning model, students are conditioned to be able to actively participate in classroom learning. It is hoped that the use of the inquiry learning model will be able to minimize the occurrence of misconceptions about science learning in elementary schools. The inquiry learning model can influence students' critical thinking skills. By using the inquiry learning model in elementary schools, it is hoped that it will be able to minimize the occurrence of misconceptions in science learning. Through the inquiry model, students are able to be trained to think critically. Thinking by producing the ability to identify a problem, analyze and determine solution steps, draw conclusions, and make decisions is the definition of critical thinking.

Research results (Azizmalayeri et al., 2012; Fuad et al., 2017) prove that inquiry learning contributes to improving students' critical thinking skills. Throughout the guided inquiry learning process, students have actively become more independent, self-confident and confident in their own intellectual abilities (Anas et al., 2022). In inquiry learning, the teacher guides students so that they are expected to be able to improve students' thinking skills through guided inquiry syntax. There are six stages of guided inquiry syntax, namely presenting a question or problem, creating a hypothesis, designing an experiment, conducting an experiment, collecting and analyzing data and making conclusions. The thinking process that emphasizes the learning process and learning outcomes as well as developing all students' potential is an emphasis on inquiry learning.

Critical thinking is an activity of analyzing ideas or ideas in a more specific direction, selecting, identifying, and developing them in a more perfect direction. Students who think critically will be seen when analyzing problems and determining relationships with science material concepts (Indriani et al., 2021). The aim of this inquiry learning model is to develop students' critical thinking skills in the learning process so that it can provide greater opportunities for them to improve learning outcomes by directing students to find answers to the problems they have studied. Always asking and questioning various phenomena being studied is one part of critical thinking. In inquiry learning, learning is not just remembering a number of facts but learning the thought process. Inquiry learning can condition students to think critically (Agustin et al., 2020). Students are given the opportunity to maximize their learning activities through the inquiry learning model. In science learning, the teacher's function and duties are as a facilitator and mediator in learning. In learning, teachers must be able to actively involve students in every learning activity. Thus, the use of the inquiry learning model in science learning in elementary schools is

expected to be able to minimize the occurrence of misconceptions in elementary schools.

Conclusion

The conclusion that can be drawn from this research is that the Inquiry Learning Model is able to improve student's critical thinking skills so that they can minimize misconceptions in science learning. Students who think critically will be seen when analyzing problems and determining relationships with science material concepts. Always asking and questioning various phenomena being studied is one part of critical thinking. From these results, the author recommends further implementation of the inquiry learning model on concepts that have many misconceptions in science learning.

Acknowledgments

We would like to express our deepest thanks to 1; Our supervisors, Mr. Julianto, S.Pd., M.Pd., and Mrs. Fitriya Hidayati, who have provided very valuable guidance, direction and input in the process of writing this work. 2; Julia Fatimatur Rahmawati, Rizka Cahyaningsih, and Irvan Surrahman who have been together in the process of preparing this article 3; Parties at the Faculty of Education, Surabaya State University, who have assisted in the funding process 4; Lecturers and staff at the Faculty of Education, Surabaya State University, who have provided very valuable knowledge and experience while we studied at this faculty 5; Our family and friends, who have provided unforgettable support, encouragement and motivation.

Author Contribution

The main and second authors, Julianto and Fitriya Hidayati contributed in guiding the writing of the article to completion, validating the article, and funding the publication of the article. The third, fourth and fifth authors Julia Fatimatur Rahmawati, Rizka Cahyaningsih, Irvan Surrahman contributed to designing, conducting research and writing the article.

Funding

This research received no external funding.

Conflicts of Interest

There was no conflict of interest in this study

References

Adbo, K., & Vidal Carulla, C. (2020). Learning About Science in Preschool: Play-Based Activities to Support Children's Understanding of Chemistry Concepts. *International Journal of Early Childhood*, *52*(1). https://doi.org/10.1007/s13158-020-00259-3

Agustin, Lady, Haryanto, Z., & Efwinda, S. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Kemampuan Berpikir Kritis Siswa Kelas XI SMA Negeri 9 Samarinda. *Jurnal Literasi Pendidikan Fisika (JLPF)*, *1*(01). https://doi.org/10.30872/jlpf.v1i01.80

Asni, A., Wildan, W., & Hadisaputra, S. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar Kimia Siswa Materi Pokok Hidrokarbon. *Chemistry Education Practice*, *3*(1). https://doi.org/10.29303/cep.v3i1.1450

Azizmalayeri, K., MirshahJafari, E., Sharif, M., Asgari, M., & Omidi, M. (2012). The development of critical thinking skills in physics and sociology curricula. *Life Science Journal*, *9*(3), 1991-1997. Retrieved from https://www.lifesciencesite.com/lsj/life0903/287_10598life0903_1991_1997.pdf

Devi, P. S., & Bayu, G. W. (2020). Berpikir Kritis dan Hasil Belajar IPA Melalui Pembelajaran Problem Based Learning Berbantuan Media Visual. *Mimbar PGSD Undiksha*, *8*(2). Retrieved from https://ejournal.undiksha.ac.id/index.php/JJPGSD/article/view/26525

Dewi, S. Z., & Ibrahim, T. (2019). Pentingnya Pemahaman Konsep untuk Mengatasi Miskonsepsi dalam Materi Belajar IPA di Sekolah Dasar. *Jurnal Pendidikan UNIGA*, *13*(1), 130-136. Retrieved from https://journal.uniga.ac.id/index.php/JP/article/view/823

Encabo-Fernández, E., Albarracín-Vivo, D., & Jerez-Martínez, I. (2023). Evaluative research on the critical thinking of primary school students. *International Journal of Educational Research Open*, *4*. https://doi.org/10.1016/j.ijedro.2023.100249

Fridberg, M., Jonsson, A., Redfors, A., & Thulin, S. (2019). Teaching chemistry and physics in preschool: a matter of establishing intersubjectivity. *International Journal of Science Education*, *41*(17). https://doi.org/10.1080/09500693.2019.1689585

Fuad, N. M., Zubaidah, S., Mahanal, S., & Suarsini, E. (2017). Improving junior high schools' critical thinking skills based on test three different models of learning. *International Journal of Instruction*, *10*(1). https://doi.org/10.12973/iji.2017.1017a

Hansson, L., Leden, L., & Thulin, S. (2020). Book talks as an approach to nature of science teaching in early childhood education. *International Journal of Science Education*, *42*(12). https://doi.org/10.1080/09500693.2020.1812011

Hilppö, J., Rajala, A., Zittoun, T., Kumpulainen, K., & Lipponen, L. (2016). Interactive dynamics of imagination in a science classroom. *Frontline Learning Research*, *4*(4). https://doi.org/10.14786/flr.v4i4.213

Indriani, R., Rabbani, S., & Pratama, D. F. (2021). Penerapan model pembelajaran savi (somatis, auditori, visual, intelektual) dalam pembelajaran daring untuk mengukur kemampuan berpikir kritis pada siswa kelas iv sekolah dasar. *Journal of Elementary Education*, *4*(6), 841-851. Retrieved from https://journal.ikipsiliwangi.ac.id/index.php/collase/article/view/5606

Kaçar, S., & Balim, A. G. (2021). Investigating the Effects of Argument-Driven Inquiry Method in Science Course on Secondary School Students' Levels of Conceptual Understanding. *Journal of Turkish Science Education*, *18*(4). https://doi.org/10.36681/tused.2021.105

Khoirunisa, I., Sitompul, S. S., & Mursyid, S. (2019). Remediasi Miskonsepsi Menggunakan Model Pembelajaran Inkuiri Terbimbing Berbantuan Mind Mapping Tentang Usaha Di Sma. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa (JPPK)*, *9*(9). Retrieved from https://jurnal.untan.ac.id/index.php/jpdpb/article/view/42645

Maharani, R. J. P., Taufik, M., Ayub, S., & Rokhmat, J. (2020). Pengaruh Model Pembelajaran Inkuiri dengan Bantuan Media Tiga Dimensi Terhadap Keterampilan Proses Sains dan Hasil Belajar Fisika Peserta Didik. *Jurnal Penelitian Pendidikan IPA*, *6*(1). https://doi.org/10.29303/jppipa.v6i1.326

Maison, M., Lestari, N., & Widaningtyas, A. (2020). Identifikasi Miskonsepsi Siswa Pada Materi Usaha Dan Energi. *Jurnal Penelitian Pendidikan IPA*, *6*(1). https://doi.org/10.29303/jppipa.v6i1.314

Milanto, S., Suprapto, N., & Budiyanto, M. (2023). Effectiveness of Contextual Learning Using the Guided Inquiry Approach to Improve Students' Scientific Literacy Ability. *Jurnal Penelitian Pendidikan IPA*, *9*(1). https://doi.org/10.29303/jppipa.v9i1.2785

Nasution, R. H., Wijaya, T. T., Adi Putra, M. J., & Hermita, N. (2021). Analisis Miskonsepsi Siswa SD pada Materi Gaya dan Gerak. *Journal of Natural Science and Integration*, *4*(1). https://doi.org/10.24014/jnsi.v4i1.10851

Ningrum, L. S., Drastisianti, A., Setiowati, H., & Pratiwi, R. (2022). Effectiveness of Cognitive Conflict-Based Chemistry Learning in Reducing Students' Misconceptions of Acid-Base Materials. *Jurnal Penelitian Pendidikan IPA*, *8*(4). https://doi.org/10.29303/jppipa.v8i4.2092

Nurdiansyah, I., Hartati, S., & ... (2022). Analisis Miskonsepsi Siswa Pada Materi Evolusi Sub-Bab Adaptasi Menggunakan Metode Three Tier Test. *Jurnal Literasi Pendidikan Dasar, 3*(2), 29-39. Retrieved from https://jurnal.unikastpaulus.ac.id/index.php/jlpd/article/view/2059

O'connor, G., Fragkiadaki, G., Fleer, M., & Rai, P. (2021). Early childhood science education from 0 to 6: A literature review. In *Education Sciences*, *11*,(4). https://doi.org/10.3390/educsci11040178

Ramdani, A., Jufri, A. W., Jamaluddin, J., & Setiadi, D. (2020). Kemampuan Berpikir Kritis dan Penguasaan Konsep Dasar IPA Peserta Didik. *Jurnal Penelitian Pendidikan IPA*, *6*(1). https://doi.org/10.29303/jppipa.v6i1.388

Rokhim, D. A., Rahayu, S., & Dasna, I. W. (2023). Analisis Miskonsepsi Kimia dan Instrumen Diagnosisnya: Literatur Review. *Jurnal Inovasi Pendidikan Kimia*, *17*(1). https://doi.org/10.15294/jipk.v17i1.34245

Vartiainen, J., & Kumpulainen, K. (2020). Playing with science: manifestation of scientific play in early science inquiry. *European Early Childhood Education Research Journal*, *28*(4). https://doi.org/10.1080/1350293X.2020.1783924

Wijayanti, M. D., Raharjo, S. B., Saputro, S., & Mulyani, S. (2018). Investigation to reduce students' misconception in energy material. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/1013/1/012080

Yulianti, E., & Zhafirah, N. N. (2020). Analisis Komprehensif pada Implementasi Pembelajaran dengan Model Inkuiri Terbimbing: Aspek Penalaran Ilmiah. *Jurnal Penelitian Pendidikan IPA*, *6*(1), 125-130. https://doi.org/10.29303/jppipa.v6i1.341