Application of the Inquiry Learning Model to Improve the Critical Thinking Ability of Class X Ecosystem Material Students at MA Alkhairaat Bolangitang Barat

Bela Safira Mantang [a,1], Ramli Utina [a,b,2], Masra Latjompoh[1,*]

[1]Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Gorontalo , Indonesia.
[2]Center for Coastal Ecology Studies Based on Local Wisdom, Universitas Negeri Gorontalo, Indonesia

[1]Belamantang17@gmail.com;[2]ramli.utina@ung.ac.id;[3]masralatjompoh@ung.ac.id

*Corresponding author: masralatjompoh@ung.ac.id

ABSTRACT

This research aims to improve students' critical thinking skills through an inquiry learning model on ecosystem material at MA Alkhairaat Bolangitang Barat. This research method is descriptive quantitative using a pre-experimental design type One Group Pretest-Posttest Design. Data were collected using observation sheets of inquiry learning implementation, student activity, and critical thinking indicator questions (tests).. The data analysis techniques used are the critical thinking ability and N-Gain categories. The average score before learning (Pre-test) was 25 and increased after implementing the inquiry learning model (Post-test) with an average score of 73. Apart from that, the normalization value of Gain was obtained from students' understanding of the Ecosystem material, reaching 0.63 with medium criteria. Based on the research results, it can be concluded that the inquiry learning model can improve students' critical thinking skills on ecosystem material. This can be seen from the results of the percentage of scores on the critical thinking ability indicator in the posttest scores which shows that the results of the students' posttest scores are higher than the pretest scores. This is because students are able to be actively involved and have the courage to ask questions and express opinions.

Keywords: Inquiry Learning Model, Critical Thinking skills.

Introduction

Learning in the 21st century will focus on student-centered learning. Learning success is shown if students understand what they have learned and are able to apply it in solving various problems in everyday life. One part of the goal of 21st-century education is the efforts made to encourage students to be able to master the skills 21st-century skills which are of course very important and useful for them to be more responsive in facing changes and growing over time. The competencies needed in the 21st century are critical thinking skills, creative skills, communication skills and collaboration skills (ŽivkoviĿ, 2016).This competency is known as the 4C competency, namely critical thinking, communication, collaboration and creativity (Sari & Wardhani, 2020).

The application of 21st century learning, one of which is often needed in the learning process, that is students' critical thinking skills, is expected to be able to improve the quality of education in Indonesia. To improve students' critical thinking skills, the teacher's ability to organize learning requires students to be actively involved in learning. Teachers must be able to provide learning models that are appropriate to the indicators of critical thinking skills. Critical thinking skills also describe other skills such as communication and information skills, as well as the ability to examine, analyze, interpret and evaluate (Afdareza et al., 2020).

Teachers must innovate to develop critical thinking skills. Applying an appropriate learning model is one of the innovations that can be achieved by being actively involved in active learning activities to discover or implement your own ideas. Inquiry learning helps students gain experience of concepts from nature, scientific skills and abilities as well as experiments in the process of raising important questions that focus on problems. Active learning through inquiry has the potential to encourage meaningful learning for a variety of students by prioritizing interesting-based interactions with scientific phenomena and stimulating discourse among students about these phenomena (Nelda et al., 2019).

Teachers, as the main pillar of education, need to make changes in the learning system. Empowering students' critical thinking skills can be done in small groups or individually in classroom learning activities. In this regard, teachers must design good learning programs and involve students in every learning activity. Critical thinking skills can also be empowered by teachers providing questions or problems that challenge students' thinking (Wartono et al., 2018). To be able to involve students actively and think critically independently in the teaching and learning process in the classroom, as well as being able to increase student retention, an appropriate learning approach using learning models is needed. Using appropriate learning models in teaching will greatly help the effectiveness of the learning process and the delivery of messages and lesson content (Fauzi et al., 2019).

The inquiry learning model is a teaching approach to motivate children to develop critical thinking skills in finding solutions to various problems through personal experience and other sources of information. The inquiry model gives priority to students' skills in carrying out critical analysis because it allows students to investigate problems in a structured manner, encourages them to use organized methods to solve problems, ask questions creatively, and create appropriate alternative answers (Wahyuningsih, 2021).

The use of learning methods that use an inquiry approach can be a solution to overcome problems in the learning process. By using this approach, students can participate actively in teaching and learning activities and are able to optimize their thinking abilities. Inquiry is an approach that involves students with active participation in the learning process with guidance from the teacher, which aims to explore the potential that exists within students. It is hoped that the inquiry learning model can help students understand the main points and ideas more effectively or optimally and improve their critical thinking skills by using better memory skills (Hermayani et al., 2015). In the inquiry learning model, students are expected to learn independently or in groups using critical thinking skills. Learning will be successful if students are able to find their own answers to the problems they want to solve. Teachers

continue to provide guidance to students so that the teacher's role shifts from being the centre of the learning process to becoming a facilitator for students.

Based on the results of interviews conducted with one of the classes in grade X Science 1. Found that mostly when teachers give students questions, it is sometimes difficult for students to solve them. From this result, it can be seen that students are less able to develop their thinking abilities. Students also still do not understand well what is conveyed by the teacher, as a result, many students still feel confused and do not understand the material being taught. Therefore researchers use the inquiry learning model, where the inquiry learning model in this case, students are also trained to be able to convey their opinions or ideas. This is because students often lack the courage to express their views in front of the class and this can hinder active involvement in the teaching stage and have an effect on the desired results. During the learning process, most students are rarely active in asking questions or expressing opinions, even though the teacher encourages students to ask questions if there are things that are still unclear or not yet understood. When the teacher asked, no students had yet provided questions and answers. The students were just silent and most of the students did not follow the teacher's explanation carefully, the students only paid attention for a moment before making noise and joking. From there it can be seen that students are not developing critical thinking analysis skills.

The inquiry learning model can be applied to Biology learning, one of which is ecosystem material to improve students' critical thinking skills. Ecosystem material is a topic that studies natural phenomena in the surrounding environment. Therefore, it can help students learn the material clearly and more easily because students make direct observations. Ecosystem material is also a biology subject that has a fairly broad object learning area. The scope of the subject is ecosystem components, interactions between ecosystem components, ecological pyramids, and productivity. Ecosystems study energy flows and biogeochemical cycles (Febriana & Kartijono, 2023).

Method

The method used in this research is a pre-experimental method using a research design, namely one group pretest-posttest design. In this design, before the treatment is given, the sample is first given a pretest (initial test) and at the end of learning the sample is given a posttest (final test).

Table I. Research design One group Pretest-posttest Design

Pretest	Treatment	Posttest
O1	X	O2

Information:
O1: initial test (pretest) before treatment is given
O2: final test (post-test) after the treatment is given
X: treatment of the experimental group, through the inquiry learning model.

Research instrument
The instruments used in this research were pretest and posttest on ecosystem material, learning implementation activity sheets, and student activity sheets. The critical thinking ability tests carried out in this research were a test of students' initial knowledge (Pre-test) and a final knowledge test (Post-test). The test in this research is in the form of critical thinking ability questions. Made in the form of essays totaling 20 numbers in the form of ecosystem questions for meeting 1 (ecosystem components and interactions in ecosystems), meeting II (Energy flow), and meeting III (Biogeochemical Cycles).

Observations are made during the learning process using the inquiry model. Observations of the implementation of learning activities and student activities are measured through observation sheets of teacher activities and student activities.

Data analysis technique

Data analysis techniques for critical thinking skills were obtained through pre-tests and post-tests in the form of scores. The research data was processed using the percentage formula (Riduwan, 2013) with the criteria for achieving critical thinking skills. The criteria for the percentage of students' critical thinking abilities were 81%-100% in the very good category, 61%-80% in the good category, 41%-60% in the medium category, 21%-40% in the poor category, and 0%-20% in the very poor category (Riduwan, 2013).

Results and Discussion

Description of Pretest and Posttest Results for Class X Science 1

Research in class X IPA 1 applies an inquiry learning model during the teaching and learning process. This research consisted of 3 meetings, at the beginning of the meeting the students were given a pre-test (initial test) and at the end of the meeting, they were given a post-test (final test) to measure the students' critical thinking abilities. Students' completeness scores must reach the minimum completeness criteria (KKM) set by the school, namely 70. The following are the results of the pre-test and post-test in class X Science 1:

Table 2. Pre-test and post-test results for Class X Science 1

No	Data	Ability to Think Critically	
		Pre-test	Post-test
1	Highest Score	33	80
2	Lowest Score	22	70
3	Average Score	25	73

Based on Table 2 above, it can be seen that before and after the application of the inquiry learning model, students' thinking skills increased between before they were given treatment (Pre-test) and after they were given treatment (Post-test). This is indicated by the average post-test score which is greater than the average pre-test score. The average pre-test score for critical thinking skills is 25, while the average score for post-test critical thinking skills is 73. This shows that there is an increase in students' critical thinking skills after learning by applying the inquiry learning model.

According to research results by Rizal (2014), learning by inquiry provides students with the opportunity to have real and active learning experiences so that students are trained in solving problems. The problem-based learning model enables students to form meaning of learning material through the learning process and store it in their memory. The problems given are real problems and are close to the environment where students stay, making it easier for students to solve problems because students are already familiar with the environment they are facing (Utami & Widiyaningrum, 2019).

Students' Critical Thinking Ability

Data on students' critical thinking skills results include pretest and posttest scores. The pretest results are used to measure students' critical thinking abilities before the research is carried out. Meanwhile, the purpose of giving post-test questions is to determine students' critical thinking abilities after implementing the inquiry-based learning model. Pretest and posttest questions contain questions about a phenomenon, then students can identify the phenomenon by formulating the problem, formulating a hypothesis, determining experimental variables, writing experimental results in a table, analyzing experimental data, making conclusions, and explaining the results of the conclusions with theory support (Saekawati & Nasrudin, 2021).

Students' critical thinking abilities are obtained from students' pretest and posttest scores. Data analysis of critical thinking skills is adjusted to critical thinking skills according to Ennis (2011). The following are the results of students' critical thinking abilities obtained from inquiry-based learning as shown in Figure 1.

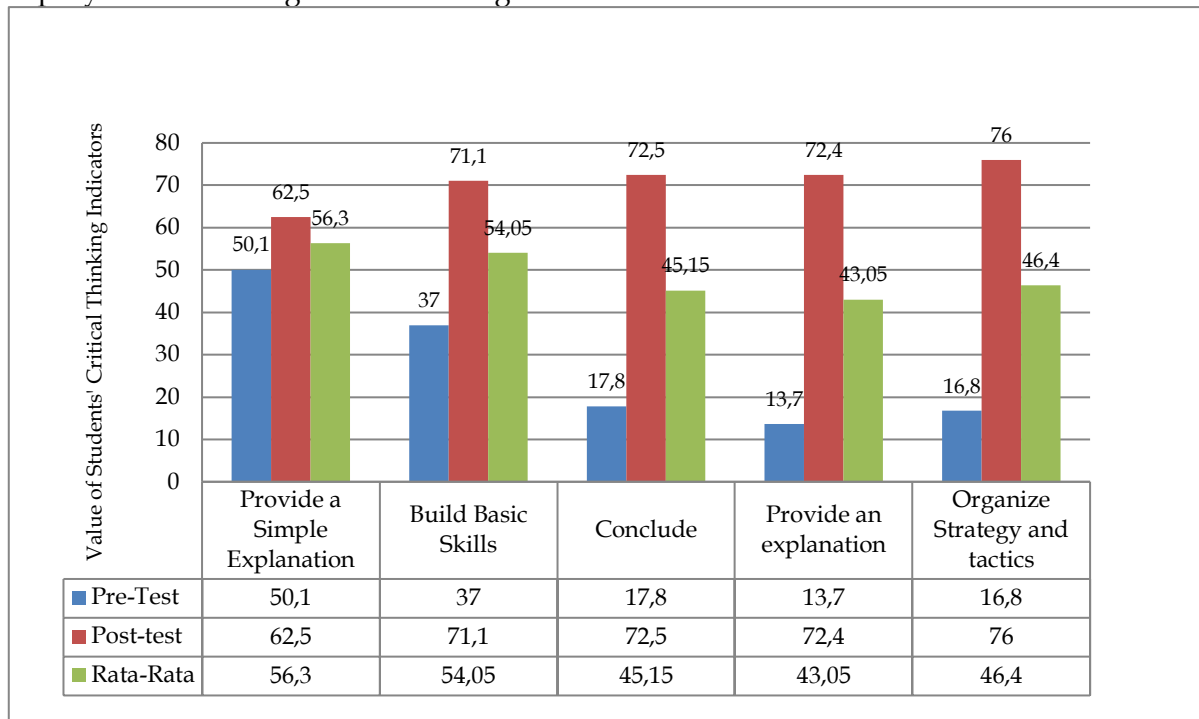|	Provide a Simple Explanation	Build Basic Skills	Conclude	Provide an explanation	Organize Strategy and tactics
Pre-Test	50,1	37	17,8	13,7	16,8
Post-test	62,5	71,1	72,5	72,4	76
Rata-Rata	56,3	54,05	45,15	43,05	46,4

Figure 1. Graphic of critical thinking abilities

Based on Figure 1, students' critical thinking abilities results, the highest score was found in critical thinking indicator, the aspect of providing a simple explanation. If we look at the pretest scores and post-test scores, students' critical thinking abilities in the aspect of providing simple explanations are categorized as moderate in the pretest scores with a score of 50.1, while in the post-test, it is 62.5 in the good category. Critical thinking skills in the aspect of building basic skills have a poor pretest score with a score of 37 and a good posttest score with a score of 71.1. Then the next aspect is To conclude, it gained pretest score with a score of 17.8 and categorized as very low and the posttest score with a score of 72.5 is categorized as good. Regarding critical thinking skills in the aspect of providing explanations, the pretest score was categorized as very poor with a score of 13.7 and the posttest score with a score of 72.4 was categorized as good. The last aspect, namely managing strategies and tactics, is almost the same as the aspect of giving an explanation, where the pretest score is categorized as very bad with a score of 16.8, while the posttest score is categorized as good with a score of 76. If the overall average for giving a simple explanation is categorized as moderate the percentage 56. 3%, to build basic skills in the medium category 54.5%, to conclude in the medium category 45.15%, to provide explanations in the medium category 43.5%, to organize strategies and tactics in the medium category 46.4%.

Based on Figure 1, it shows that the indicator provides a simple explanation with an average value of 56.3%. The indicator of building basic skills has an average value of 54.05%, the indicator concluding with an average value of 45.15%, the indicator of providing explanations has an average value of 43.05%, and the indicator of organizing strategies and tactics has an average value of 46.4%. Among the five aspects of critical thinking indicators, these are included in the medium category. This means that students can work on questions by analyzing the questions given by the teacher. However, students' answers to each indicator are not perfect because they are not accompanied by arguments that support the problem-solving answer. The research results are supported by Saregar et al. (2018), who state that

students with moderate critical thinking skills are characterized by the imperfect or uneven achievement of indicators for each indicator of critical thinking skills.

Understanding the concepts in the material is also felt to be better understood by students because teachers in the inquiry learning process can always condition students to be able to think critically and actively in finding or solving problems, where each phase of inquiry model learning is carried out well and in the learning process they always ask questions and ends by concluding together. The results of students' good critical thinking abilities on several indicators show that the inquiry model can develop students' critical thinking abilities. This is supported by the findings of Wardani et al. (2016), which state that applying the inquiry learning model in learning affects student activity, as evidenced by the increased achievement of posttest scores. This research also aligns with research conducted by, which states that the inquiry learning model can make students respond positively to the learning process with the concept of the learning material provided.

Increasing students' critical thinking abilities can be derived from tests carried out before starting learning, known as a pretest. The results of research on the application of the inquiry learning model to improve students' thinking abilities show that there are indicators where students still need additional treatment: clarifying, interpreting statements and ideas, and analyzing, evaluating, and producing explanations. Based on learning activities, students are less enthusiastic about finding new ideas from the results of their analysis. Student inactivity tends to make students less able to create new ideas. It was also found by Ramawati (2016) that students appeared passive in discussions; some students answered not seriously.

Critical thinking indicators were not completely fixed in this study. Some indicators are superior, and some are low, so additional treatment is needed. Thinking indicators are still low, apparently, students are still not used to thinking analytically to create new ideas. This condition was also experienced by Widayanti (2020); students' weak critical thinking abilities are caused by learning that does not give students active thinking, and there are no questions from teachers who train students to think to solve problems. Based on the graph above, it can be concluded that students' critical thinking abilities are not yet optimized from all indicators (Wati et al., 2021).

Gain Normality (N-Gain)
N-Gain data on student learning outcomes is obtained from the difference between the initial score on the Pre-test and the final score on the Posttest in the inquiry learning model. Analysis of N-Gain data which discusses Ecosystem material can be seen in Table 3 below.

Table 3. N-Gain analysis of student learning outcomes

Mark	*Pre-Test*	*Post-Test*	N-Gain	criteria
Average	25.4	72.8	0.63	currently

The N-Gain test determines how much students' critical thinking abilities have improved after being given an inquiry-based learning model. Students can be declared to have improved if the N-gain score obtained reaches the medium criteria ($0.3 < g < 0.7$) or high ($g > 0.7$). Learning can be said to be effective if the N-gain value is included in the medium or high criteria (Saekawati & Nasrudin, 2021).

Based on the data in Table 3, it can be seen that the difference between the average score before learning (Pre-test) was 25.40 and there was an increase in the Post-test, namely 72.8. Apart from that, the average normalized Gain obtained from students' understanding in studying Ecosystem material reached 0.63 with medium criteria. This is because students are able to solve questions that require students' critical thinking, this cannot be separated from the use of the inquiry learning model.

The N-Gain results with medium criteria are obtained from the results of each individual student's pretest and posttest scores, where the student's pretest score (initial score) is with an average score of 25 medium criteria, while the posttest score (final score) is with an average score 73 as high criteria. The results analysis of the increase in critical thinking skills (N-Gain) scores presented in Table 3 show that in the pretest, none of the indicators were completed, while in the posttest, all indicators were completed. The improvement that occurs is also inseparable from the role of students in following the learning process using the inquiry model. Increasing students' critical thinking abilities proves that the inquiry learning model provides opportunities for students to learn actively in formulating problems, analyzing, drawing conclusions and other skills that can provide positive value in terms of students' critical thinking abilities. Based on this description, it can be proven that the inquiry learning model can improve the critical thinking skills of class X Science I students on Ecosystem material.

Conclusion

Based on the research that has been conducted, it can be concluded that the inquiry learning model is able to improve students' critical thinking skills on ecosystem material. The students' critical thinking abilities can be seen from the percentage results of the critical thinking indicators in the average post-test value which increased compared to the average value of the pretest. It suspected because the inquiry learning model encourages students to always be active and use their thoughts to answer questions from the teacher. The success that occurs after implementing this inquiry model can be attributed to changes in students' learning methods, where they do not just rely on rote memorization but involve deeper thinking processes.

Based on the N-Gain results, it shows that the average N-Gain value is 0.63, which is included in the medium category. So it can be concluded that the inquiry learning model applied in class X IPA 1 is effective in improving students' critical thinking skills. The improvement that occurred showed that the teacher had made improvements based on the analysis and reflection that had been carried out previously at meeting I. The improvement that occurred was also inseparable from the role of students in following the learning process using the inquiry model. Increasing students' critical thinking skills proves that the inquiry learning model provides opportunities for students to learn actively in formulating problems, analyzing, drawing conclusions and other skills that can provide positive value in terms of students' critical thinking abilities. Based on this description, it can be proven that the inquiry learning model can improve the critical thinking skills of class X Science I students on Ecosystem material.

Reference

Afdareza, M. Y., Yuanita, P., & Maimunah. (2020). Development of Learning Device Based on 21st Century Skill with Implementation of Problem Based Learning to Increase Critical Thinking Skill of Students on Polyhedron for Grade 8th Junior High School. *Journal of Educational Sciences*, 4(2), 273–284. https://doi.org/https://doi.org/10.31258/jes.4.2.p.273-284.

Asmarani, I., Woro, S., & Wardani, S. (2017). Development of Inquiry-Based Motoin Comic Media to Develop Critical Thinking Skills. *Journal of Chemistry in Education*, 6(1), 27–32. https://journal.unnes.ac.id/sju/chemined/article/view/14280.

Azriani, N., Islami, N., Hermita, N., Nor, M., Syaodih, E., Handayani, H., Zulirfan, Z., Suhandi, A., Malik, A., Mahbubah, K. (2019). Implementing Inquiry Learning Model To Improve

Primary School Students' Critical Thinking On Earth And Universe Concept. *Journal of Physics:Conf., Series 122*(012033). https:// 10.1088/1742-6596/1227/1/012033

Fauzi, A., Djulia, E., & Idramsa. (2019). The Effect Of Inquiry Learning Model And Groupinvestigation Learning Model On Students' Cognitive Skills And Critical Thinking Skills In The Ecosystemtopic At SMA Bhayangkari 1 Medan. *Proceedings of the 4th Annual International Seminar on Transformative Education and Educational Leadership (AISTEEL 2019).* http://creativecommons.org/licenses/by-nc/4.0/.

Febriana, D. R., & Kartijono, N. E. (2023). Development of Ecosystem E-Module Based on Inquiry Learning to Improve Students' Learning Outcomes. *Journal of Biology Education, 12*(1), 94–103.
https://doi.org/https://doi.org/10.15294/jbe.v12i1.65373

Hermayani, A. Z., Dwiastuti, S., & Marjono, M. (2015). Peningkatan Motivasi Belajar Dan Kemampuan Berpikir Kritis Siswa Pada Materi Ekosistem Melalui Penerapan Model Inkuiri Terbimbing. *BIOEDUKASI (Jurnal Pendidikan Biologi), 6*(2). https://doi.org/10.24127/bioedukasi.v6i2.335

Ramawati, I. (2016). Utilization of the surrounding environment as a learning resource to improve critical thinking skills. *Geography Journal, 16*(1), 66–87. https://doi.org/https://doi.org/10.17509/gea.v16i1.3469

Riduwan. (2013). *Basics of Statistics.* Alphabeta.

Rizal, M. (2014). The Effect of Guided Inquiry Learning with Multiple Representations on Science Process Skills and Mastery of Science Concepts in Middle School Students. *Journal of Science Education, 2*(3), 159–165. https://dx.doi.org/10.17977/jps.v2i3.4509

Saekawati, R., & Nasrudin, H. (2021). Effectiveness of Guided Inquiry-Based on Blended Learning in Improving Critical Thinking Skills. *Journal of Educational Science Research, 14*(1), 53–68. https://doi.org/https://doi.org/10.21831/jpipfip.v14i1.367

Saregar, A., Irwandani, İ., Abdurrahman, A., Parmin, P., Septiana, S., Diani, R., & Sagala, R. (2018). Temperature and Heat Learning Through SSCS Model with Scaffolding: Impact on Students' Critical Thinking Ability. *Journal for the Education of Gifted Young Scientists, 6*(3), 39–54. https://doi.org/.https://doi.org/10.17478/JEGYS.2018.80

Sari, D. M. M., & Wardhani, A. K. (2020). Critical Thinking as Learning and Innovation Skill in the 21st Century. *Journal of English Language and Pedagogy, 3*(2), 27–34. https://doi.org/https://doi.org/10.36597/jelp.v3i2.8778

Utami, A. B., & Widiyaningrum, P. (2019). The Effectiveness of School Environment Based Inquiry Model in the Ecosystem Material Towards Critical Thinking Ability and Environmental Caring Attitudes of High School Students. *Journal of Biology Education., 8*(3), 367–374. http://journal.unnes.ac.id/sju/index.php/ujbe

Wahyuningsih, S. (2021). Literacy Study of Inquiry Learning Models to Improve Student Learning Outcomes. *Didactics, 15*(2), 26–39.

Wardani, S., Setiawan, S., & Supardi, K. I. (2016). The Effect of Guided Inquiry Learning on Understanding Concepts and Oral Activities on the Main Material of Reduction and Oxidation Reactions. *Journal of Chemical Education Innovation, 10*(2), 1743–1750. https://doi.org/https://doi.org/10.15294/jipk.v10i2.9527

Wartono, Hudha, M. N., & Batlolona, J. R. (2018). How Are The Physics Critical Thinking Skills of The Students Taught by Using Inquiry-Discovery Through Empirical and Theoretical Overview. *Journal of Mathematics, Science and Technology Education, 14*(2), 691–697. https://doi.org/https://doi.org/10.12973/ejmste/80632

Wati, W., Kartimi, K., & Mulyani, A. (2021). Application of Biology Learning Based on Local Wisdom Cibulan Tourism to Improve Students' Critical Thinking Skills. *Scientiae Educatia: Journal of Science Education, 10*(2), 148–159. https://doi.org/https://doi.org/10.24235/sc.educatia.v10i2.9356

Widayanti, E. (2020). The potential of scientific learning with ethnoscience nuances to empower students' critical thinking abilities. *Wahana Didaktika: Journal of Educational Sciences*, *18*(1), 82–94. https://doi.org/https://doi.org/10.31851/wahanadidaktika.v18i1.4352

ŽivkoviĽ, S. (2016). A Model of Critical Thinking as An Important Attribute for Success in the 21st Century. *Procedia-Social and Behavioral Sciences*, *23*(2), 102–108. https://doi.org/https://doi.org/10.1016/j.sbspro.2016.10.034