



Analysis of Student Metacognitive Relationships with Problem-Solving Abilities in Biology Learning

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Abstract

Background: Problem-solving is a skill that students must master in the 21st century. In Biology learning, students' ability to solve problems uses their metacognitive skills to process information and knowledge to solve problems. This study describes the relationship between metacognitive skills and problem-solving abilities in Biology learning in class XI Science. **Methods:** Correlation descriptive research method with Cluster Random Sampling technique many 52 students. The questionnaire instrument to capture metacognitive skills was 14 statement items with a Likert Scale, and the essay test instrument for problem-solving skills was six questions. Data analysis technique using SPSS verse 24. **Results:** The hypothesis test shows that the correlation coefficient R is $0.123 > 0.05$, which means there is no relationship. The relationship is positive in the regression equation $Y' = 43.6 + 0.245X$. In the analysis of variance, the F count value of 0.771 with a significance of $0.384 > 0.05$ means that it is not significant. **Conclusions:** The conclusions that can be formulated are that H_a is rejected and H_0 is accepted. There is no significant relationship between students' metacognitive skills and problem-solving abilities in Biology learning. The project-based learning method might be implied to train problem-solving skills in the student environment so that distance learning obstacles can be minimized.

Keywords: Biology Learning; Metacognitive Skills; Problem-Solving Ability



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Introduction

Education carried out at all levels of education can explore individuals' potential to face future challenges. Learning in the 21st century, which is the century of knowledge, requires students to have several abilities, including critical thinking, problem-solving, creativity and innovation, communication, and collaboration. This requires students to have the ability to solve problems.

Problem-solving is the ability of individuals who use the thought process to solve a problem by collecting facts, analyzing information, compiling various alternative solutions, and choosing the most effective problem-solving (Rahma et al., 2020). This ability is essential in the student's learning process to assist him in making the right decisions. Solving problems by looking for information and knowledge from various sources will help solve problems to make the right decisions.

The selection of decisions depends on the student's metacognitive skills to process the information obtained to solve the problem. Metacognitive skills are a form of thinking awareness to process one's thought processes to generate motivation to improve the frame of mind when facing unsolved problems (Paristu, 2020). Sometimes students have metacognitive knowledge, but it is challenging to use it to solve a problem (Suryaningtyas

& Setyaningrum, 2020). In learning biology contextual to life problems, it is necessary to train problem-solving skills so that students can make the right decisions.

Metacognitive skills need to be possessed by students because they are related to their thought processes to solve problems. Different metacognitive abilities cause teachers to need to facilitate students in the learning process to solve problems. However, the reality is that both students' metacognitive and problem-solving abilities are still underdeveloped (Afni et al., 2020), that students' metacognitive skills have not been so developed with results in the planning aspect of 23%, the monitoring aspect of 45% and the evaluation aspect of 43%. The average score of problem-solving ability is 39.9%, which means that students are still lacking (I Wayan, 2006).

The distinguishing aspect of this study is that the Distance Learning (PJJ) process is ongoing. Because the outbreak of the Covid-19 virus, therefore, requires an online learning process. The study also describes students' metacognitive abilities in solving problems.

Method

This quantitative descriptive study involved a sample of 52 class XI students obtained through the Cluster Random Sampling technique.

Instrument

The question instrument to capture students' problem-solving abilities uses six essay questions in which there are problems regarding biological material related to live. The preparation of the problem uses problem-solving steps, according to Paidi (2011). After logical and empirical validity tests are carried out, are carried out to analyze the quality of the instrument using tests of validity, reliability, difficulty level, and distinguishing power. Furthermore, the instrument can be used for student data retrieval by spreading a google form link. The required test using normality and linearity tests was then carried out with hypothesis tests with the help of the SPSS ver. 24.

Data collection

Data collection techniques are in the form of non-tests (questionnaires) and tests (questions). The questionnaire instrument to obtain data on students' metacognitive skills uses the Likert scale with 14 statements regarding metacognitive skills arranged based on three aspects according to Vrugt & Oort (2008): planning, monitoring, and evaluation.

Result

Students Metacognitive Skills

Data on students' metacognitive skills are listed in Table 1.

Table 1. Description of student metacognitive skills data

Average	Standard Deviation	Maximal Value	Minimum value
63,79	7,13	80	48

Judging from the results of obtaining a standard deviation value of 7.13, the data obtained from this metacognitive skill is less varied because the standard deviation value obtained is less than the average. This shows that students answer less diversely. The average gain of 63.79 shows the metacognitive skills possessed by high-category students. Based on the aspects of metacognitive skills, students are superior to monitoring skills, namely indicators of supervision of the learning process and awareness of the implementation of tasks, compared to aspects of planning skills and evaluation skills; this is shown by students who have been able to manage how to learn so that students can do their assignments well.

Troubleshooting Capabilities

The results of the data analysis of students' problem-solving abilities are listed in Table 2.

Table 2. Description of student problem-solving ability data

Average	Standard Deviation	Maximal Value	Minimum value
59,27	14	86	33

The analysis results of the problem-solving ability obtained a standard deviation value of 14, which means that the data spreads less variably. The average obtained in the study was 59.27, which showed that students' problem-solving ability was sufficient. Based on the aspect of problem-solving ability, students are only able to identify possible solutions and choose the best solution. In addition, students have not been able to think in sequence in solving problems, judging from the answers of students who directly answer at the stage of implementing solutions.

Relationship of metacognitive skills with problem-solving ability

The research data obtained on Sig. $0.20 > 0.05$ showed that the data was normally distributional. Probability at deviation from linearity with probability Sig. $0.179 > 0.05$. Thus, the research data on metacognitive skills and problem-solving ability are normally distributed and have linear relationships.

The calculation of a simple regression equation on the variables of metacognitive skills and problem-solving ability yielded a regression coefficient of 0.245; This shows that every time you add a unit of metacognitive skill value, the value of problem-solving ability increases by 0.245. The results show a positive relationship between metacognitive skills and problem-solving ability.

The value of the correlation coefficient R was obtained by $0.123 > 0.05$, indicating no relationship between the metacognitive skill variable and the problem-solving ability. Furthermore, the variance analysis results to determine the significance of the relationship obtained the value of $F = 0.771$ with a significance of 0.384. This shows that Sig. = $0.384 > 0.05$ means that the regression coefficient between metacognitive skill variables and problem-solving ability is insignificant. (H_a is rejected, and H_0 is accepted).

Discussion

Statistical tests showed that metacognitive skills did not significantly correlate with the problem-solving ability (an F value of 0.771 with a Sig. of $0.384 > 0.05$). According to Anderson et al. (2001), metacognitive belongs to the dimension of knowledge, which is the knowledge of consciousness and the process of cognition in the learning process; This is due to the situation that requires distance learning (PJJ) which during the learning process uses e-learning so that it cannot improve students' problem-solving abilities.

E-learning learning often experiences problems related to network connections and technical errors such as server downs and errors. One problem of distance learning lies in the lack of mastery of technology, data packages, and internet networks (Sofianto & Zuhri, 2021). Ineffectiveness in implementing PJJ due to economic, technological, and infrastructure factors, not having supporting electronic media, and weak network/signal conditions (Sinaga et al., 2020). Other obstacles are teachers who are not used to providing material remotely and how to deliver the material with limited time so that the material is not delivered correctly. In addition, teachers give assignments related to the material and use fewer media and learning strategies. According to Marthaningrum (2020), to support the learning process, namely by using e-learning learning, it must be genuinely mastered by the teacher because it is one of the deliveries of learning materials to students. The use of media and learning creativity are factors for the success of distance learning. Still, obstacles to the media system or the readiness of teachers and learners will hinder learning activities (Aprilianto & Putra, 2020).

The learning environment also affects improving students' abilities. Distance learning, which is applied, requires students to study at home. Because an obstacle for students in the learning process where students are less motivated to study independently at home. The condition of the learning environment is a factor in the decrease in learning motivation. Distance learning can also result in students experiencing academic stress, where students feel pressured by academic demands such as schoolwork that burden students (Pahriji, 2021). Students experience moderate (49%) and high (10%) stress levels, so the majority of students experience academic stress (Safira et al., 2021). The weak internet signal on students' devices makes students restless and less motivated to learn.

The lack of self-confidence results in low problem-solving ability; it is characterized by students answering problems not using their thought processes but by asking friends or looking for answers on the internet, which causes a difference between metacognitive skills and problem-solving abilities. Lack of trust in himself makes him fear being wrong, unsure, and unable to cope with his problems (Lestari & Sofyan, 2013). Students' self-confidence plays a role in learning activities, and self-confidence affects students' independence in making decisions without the influence of others (Pratiwi & Laksmiwati, 2016).

Based on the results of students' metacognitive skills, which are relatively high, students' scores are more excellent in monitoring skills in which there are indicators of supervision of the learning process and awareness about performing tasks. Students can manage their learning and thinking processes to perform a task. Metacognitive skills are a form of thinking awareness to process their thought processes so that they are motivated to improve their way of thinking in dealing with problems (Paristu, 2020).

Problem-solving skills include identifying problems, analyzing the causes of problems, identifying solutions, choosing the best solution, developing action plans, and implementing solutions. Based on the findings, the student's problem-solving ability is categorized as sufficient (students can answer at the stage of identifying possible solutions and choosing the best solution). Students understanding in analyzing and understanding problems can find several solutions and choose the best solution by making decisions according to their knowledge and information. Inaccuracy in decision-making will impact problem-solving quality (Paid, 2011).

The results of this study revealed that students had not identified the problem in detail, as can be seen from the student's thinking steps that are directly focused on the implementation of the solution so that the problem-solving ability is not in order. Students are poorly trained to solve problems that require solving problems in a sequence and logical manner. PBL and student worksheet (LKS) models based on problem-solving skills may improve students' problem-solving abilities (Lestari et al., 2017). Internal and external factors influence students' learning abilities (Ildayanti, 2017). The success of achieving learning objectives depends on the learning process experienced by students, each individual has a different way of thinking, so it is hoped that the learning process, which includes strategies and methods, should meet aspects of metacognitive skills and problem-solving abilities. Teachers can be a reference for teachers who want to develop student metacognitive skills to improve students' problem-solving ability by using specific models, methods, or strategies in the learning process. In this study, there was no correlation between metacognitive and problem-solving ability, although metacognitive played a role in solving problems. The learning process is very influential in improving students' problem-solving abilities.

Conclusions

The conclusion of this study refers to the metacognitive skills of high-category students and the problem-solving ability of suitable categories. Metacognitive skills and problem-solving abilities do not significantly relate to biological learning. The project-based learning method may be implied to train the problem-solving ability in the student environment so that distance learning constraints can be minimized.

Declaration statement

The authors reported no potential conflict of interest.

References

- Afni, N., Pallenari, M., & Rachmawaty. (2020). Profil Keterampilan Meakognitif Siswa SMA di Kecamatan Mamajang Kota Makassar Materi Sistem Pencernaan Metacognitive Skill Profile Student Senior Hight School Mamajang District Makassar City Material of the Digetive System. *Prosiding Seminar Nasional Biologi FMIPA UNM Inovasi Makassar, 8 Agustus 2020*, 130–137.
- Anderson, L. W., Krathwohl Peter W Airasian, D. R., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, J., & Wittrock, M. C. (2001). *Taxonomy for Assessing a Revision of Bloom's Taxonomy of Educational Objectives*. Pearson Education.
- Aprilianto, R., & Putra, M. (2020). *Kendala Pelaksanaan Pembelajaran Jarak Jauh (PJJ) dalam Masa Pandemi*.
- I Wayan, K. (2006). Profil Kemampuan Pemecahan Masalah Biologi Siswa SMA di Kota Mataram. *Jurnal Ilmiah Biologi "Bioscientist,"* 2(1), 54–61.
- Ildayanti. (2017). The Correlation of Thinking Abilities and Metacognitive Awareness on Biology Learning Results of Class XI IPA Students at Public Senior High Schools in Pinrang District. *Skripsi*.
- Lestari, H. N., Suganda, O., & Widiyantje, R. (2017). Kemampuan Pemecahan Masalah Melalui Model Problem Based Learning (PBL) pada Konsep Pencemaran. *Quangga: Jurnal Pendidikan Dan Biologi*, 9(2), 23–31. <https://doi.org/10.25134/quangga.v9i02.745>
- Lestari, T. P., & Sofyan, D. (2013). Perbandingan Kemampuan Proses Pemecahan Masalah Antara Siswa yang Menggunakan Pembelajaran Creative Problem Solving (CPS) dan Konvensional. *Mosharafa: Jurnal Pendidikan Matematika*, 2(3).
- Marthaningrum, E. (2020). Problematika Pembelajaran E-Learning Bagi Guru Kelas Rendah Di Tengah Pandemi Covid 19. *Journal of Chemical Information and Modeling*, 53(9), 1689–1699.
- Pahriji, I. A. (2021). Pengaruh Lingkungan Belajar Terhadap Motivasi Belajar Mahasiswa Dalam Pembelajaran Jarak Jauh Selama Pandemi. *Jurnal Citra Pendidikan*, 1(3), 380–387.
- Paidi. (2011). Pengembangan Perangkat Pembelajaran Biologi Berbasis Masalah. *Jurnal Kependidikan*, 41(2), 185–201.
- Paristu, B. P. (2020). Pengaruh Pendekatan Metakognitif dan Kemampuan Awal Matematis terhadap Kemampuan Berpikir Reflektif Matematis Siswa. *Skripsi*, 1–61.
- Pratiwi, I. D., & Laksmiwati, H. (2016). Kepercayaan Diri dan Kemandirian Belajar Pada Siswa SMA Negeri "X." *Jurnal Psikologi Teori Dan Terapan*, 7(1), 43–49. <https://doi.org/10.26740/jptt.v7n1.p43-49>
- Rahma, I., Windyariani, S., & Suhendar. (2020). Profile of Problem Solving Capabilities of High School Students in Ecosystem Materials. *Biodik*, 6(3), 281–289. <https://doi.org/10.22437/bio.v6i3.9551>
- Safira, L., Theresia, M., & Hartati, S. (2021). Gambaran Stres Akademik Siswa SMA Negeri Selama Pembelajaran Jarak Jauh (PJJ). *Empati: Jurnal Bimbingan Dan Konseling*, 8(1), 125–136.
- Sinaga, L., Harahap, K. R. P., Sihalo, C. A. P., & Bukhari, I. (2020). Analisis Strategi Pembelajaran Jarak Jauh Pada Materi Ipa Selama Pandemi Covid-19 Di Kota Medan. *JPPIPAI: Jurnal Pendidikan Pembelajaran IPA Indonesia*, 1(1), 29–33.
- Sofianto, A., & Zuhri, M. (2021). Hambatan Dan Solusi Pembelajaran Jarak Jauh Pada Era Pandemi Covid-19 Di Jawa Tengah. *Jurnal Pendidikan Dan Kebudayaan*, 6(2), 173–186. <https://doi.org/10.24832/jpnk.v6i2.1841>
- Suryaningtyas, S., & Setyaningrum, W. (2020). Analisis kemampuan metakognitif siswa SMA kelas XI program IPA dalam pemecahan masalah matematika. *Jurnal Riset Pendidikan Matematika*, 7(1), 74–87. <https://doi.org/10.21831/jrpm.v7i1.16049>
- Vrugt, A., & Oort, F. J. (2008). *Metacognition , achievement goals , study strategies and academic achievement : pathways to achievement*. <https://doi.org/10.1007/s11409-008-9022-4>