Assimilation: Indonesian Journal of Biology Education
ISSN 2621-7260 (Online)
Journal homepage: https://ejournal.upi.edu/index.php/asimilasi

Analysis of students' numeracy skill in genetics topic based on minimum assessment competency

Listia Andriani*, Sariwulan Diana, Topik Hidayat
Department Biology Education FPMIPA Universitas Pendidikan Indonesia, Dr. Setiabudi No. 229 Street Bandung
*Corresponding author: listiaandriani@upi.edu

OPEN ACCESS

ARTICLE HISTORY
Received: 18 August 2022
First Revised: 20 September 2022
Accepted: 30 September 2022
First Available Online: 30 September 2022
Publication Date: 30 September 2022

KEYWORDS
AKM
Genetics
Numeracy

ABSTRACT

Genetics is a biology topic that applies several mathematics principles. It causes numeracy skills in genetics to be important for students. Therefore, a good mastery of numeracy skills could help students to solve genetics problems and achieve genetics competencies. Based on this statement, this study was conducted to analyze the numeracy skills of class XII based on the Minimum Competency Assessment (*Asesmen Kompetensi Minimum*/AKM). Fifty-four students were involved as research participants. Furthermore, 30 questions were used in this study. The result showed that the numeracy skills of class XII were still in the low category due to the lack of experience in solving AKM-type questions, learning experience, mathematics ability, mastery of genetics concepts, and students' perceptions of genetics. The low students' performance on numeracy skills should be considered especially by an education provider to adjust the learning implementation that can improve students' numeracy skills in genetics.

INTRODUCTION

Twenty first century skills are necessary to face the challenges of the future. Twenty first century skills themselves are divided into three categories; learning skills, literacy skills, and life skills (Szabo et al., 2020). These skills are important to possess in order to be able to compete and survive in the era of knowledge, data and technology-based development. Twenty first century skills are considered essential for a wide range of people from different countries and cultures with different contexts to interact in a borderless, interconnected, and globalized world (Teo, 2019). In addition, 21st century skills are needed to cope with various issues that may occur in the future, such as socio-economic problems and natural changes. The importance of having 21st century skills has made different countries around the world, including Indonesia, strive to develop these skills through education. This is done to prepare students as the next generation who have superior competence and are able to adapt.

Numeracy is an essential skill for students in the 21st century, as it is critical to support the variety of careers they may pursue (Sepriyanti et al., 2022). According to Kumar & Behera (2022), numeracy refers to the ability to identify and apply mathematical principles in various areas of life, and to carry out a given task with consistent results and efficient performance, often within a limited period of time. Pusat Asesmen dan Pembelajaran defines numeracy as the ability to think using mathematical concepts, procedures, facts, and tools to solve everyday problems in various types of contexts that are relevant as Indonesian citizens and citizens of the world. Therefore, numeracy is not only about understanding mathematical concepts, but also about being able to apply them in everyday situations. Numeracy skills are very important in the process of making the right decisions in everyday life (Garcia-Retamero et al., 2019). Although it uses mathematical skills, numeracy is different from mathematics. Mathematics tends to be abstract and represents absolute truths, while numeracy is more concrete and practical in making decisions in various contexts of real-life situations (Umbara & Suryadi, 2019). Having a good numeracy-skills can aid students to solve problems related to quantitative matters more logically and critically. If someone has low numeracy skills, it can limit them in interpreting risks accurately (Garcia-Retamero et al., 2019). In addition to solving everyday problems, the ability to master competencies in a subject that applies mathematical principles in its solution, is essential. One example of such subject is genetics. In genetics, there are several topics that apply mathematical rules, such as Mendelian genetics, human heredity patterns, and population genetics. Genetics is a subject that is often seen as difficult by students (Osman et al., 2017). Even most students around the world consider genetics a difficult subject, especially numerical problems in genetics (Gupta, 2019). Students find the material in genetics subject matter to be difficult due to the use of mathematical principles (Çimer, 2012; Ozcan et al., 2014). Based on the explanation, good numeracy skills can make it easier for students to be better prepared to solve mathematical problems in certain contexts and can help students master a number of topics in the genetic material.

However, the data shows that the level of numeracy skills of Indonesian students is still in the low category (Muzaki & Masjudin, 2019). This can be observed in general as well as in specific subjects. In addition, if we look at the PISA and TIMSS rankings, the results of Indonesian students have not shown optimal result. Indonesia ranked 72nd out of 79 countries based on PISA scores (Utaminingsih & Subanji, 2021). This shows that the numeracy performance of Indonesian students has not shown encouraging results.

The poor numeracy skills of students prompted the Indonesian government to launch a program to improve students' numeracy skills. One of the programs developed by the government is the National Literacy Movement. Then, in 2020, Kemdikbud designed a new program, called the National Assessment (NA) as a replacement for the National Exam. The NA is implemented with the aim of describing student learning outcomes and the quality of education provision in education units. The AN contains Minimum Competency Assessments (Asesmen Kompetensi Minimum/AKM) that test basic competencies, one of which is numeracy. The results of the AKM in

DOI: https://doi.org/10.17509/aijbe.v5i2.49709
e-ISSN 2621-7260

numeracy are expected to be a reference for the implementation of improvements and enhancements of the educational system and quality in the development of numeracy skills. (Tju & Murniarti, 2021). With standardized assessments in place, education policymakers can determine whether established education standards are being met and provide support and improvements to local governments, schools, and individuals to better meet the standards and allows for objective evaluation and improvement of education system (Howard et al., 2016).

Based on the explanation above, this research was conducted to analyze the level of students' numeracy skills in genetics material. This study also analyzed students' achievements at each cognitive level of numeracy so that students' ability to solve problems can be known. Minimum Competency Assessment (AKM) type questions were used in this study to be in line with the program being implemented in Indonesia. The findings of this study can be used as a benchmark for students' abilities in genetics material so that the implementation of education can be adjusted in order to hone students' numeracy skills in genetics material.

METHODS

The method used in this research is descriptive quantitative which only describes the numeracy skills of students on genetic material without certain treatment. This research was conducted at SMAN X Bandung involving 54 students as research subjects. The research subjects were selected based on cluster random sampling technique. The research subjects were asked to work on genetics test questions of the AKM type which were uploaded on the google form link within 90 minutes.

The instrument used in the study refers to the type of AKM questions consisting of context, concept, and cognitive process levels. Students were presented with 30 test questions consisting of 18 multiple choice questions, 5 complex multiple-choice questions, and 7 description questions. The content tested through test questions includes data and uncertainty and algebra with cognitive levels of understanding, application, and reasoning. The genetics subject used as a context is a topic that applies mathematical principles, which is Mendelian genetic trait inheritance, patterns of heredity in humans, and population genetics.

Then, the data obtained through the implementation of the study will be analyzed with descriptive statistics. Descriptive statistics used is to determine the average student test scores. The average score is used to determine the level of students' numeracy skills on genetic material based on predetermined criteria by Pusat Asesmen dan Pembelajaran (Table 1).

Table 1. Criteria for numeracy ability of class XII students on genetics

Score	Criteria	AKM Outcomes
90 ≤ N ≤100	Very high	Proficient
80 ≤ N < 90	High	Capable
75 ≤ N < 80	Standard	Capable
60 ≤ N < 75	Rather low	Basic
45 ≤ N < 60	Low	Need special intervention
< 45	Very low	Need special intervention

RESULTS AND DISCUSSION

Level of numeracy ability of class XII high school students on genetics subject

Research on the numeracy skills of XII grade high school students on genetics subject has been completed. The results of the research are contained in Table 2. The data in Tabel 2 shows that students of SMAN X Bandung in grade XII do not have good numeracy skills in genetics. The level of numeracy skills of high school students in grade XII in genetics is still relatively low. Then, based

DOI: https://doi.org/10.17509/aijbe.v5i2.49709
e-ISSN 2621-7260

on the categorization of each student's test scores, it can be seen that almost all students need special intervention. This can be used as a reference for education providers to focus on developing students' numeracy skills in genetics according to their ability levels. The implementation of this special intervention is expected to improve students' numeracy skills in learning about genetics.

Table 2. Test scores and achievement of minimum competency assessment (AKM) of XII grade students on genetics subject

Test Scores			Criteria	Standard Deviation	AKM Outcomes	
Average	Highest Score	Lowest Score			Percentage (%)	Description
55,67	71,88	31,25	Low	±7,69	75,93	Need Special Intervention

Based on the data in Table 2, there are several factors that are thought to be the cause of the low level of numeracy skills of grade XII high school students in genetics material. These factors are students' experience on answering Minimum Competency Assessment (AKM) type questions, students' learning experience, mathematical ability, mastery of genetics concepts, and students' perceptions of themselves and genetic material.

The lack of student experience in working on Minimum Competency Assessment (AKM) type questions is thought to cause the low level of student numeracy skills in genetics material. This lack of experience causes students to be unfamiliar with working on questions of this type, resulting in poor test results. Students who are accustomed to working on problems with the AKM type will find it easier to work on similar test questions so that they can show better test results, while students who are not used to it will show different results. The lack of student experience with AKM-type genetics problems can be caused by limited class hours at school. This is consistent with the findings in the field which show that biology class hours have been cut. Thus, the subject teachers focus more on delivering the core material of genetics rather than specifically practicing numeracy skills.

Furthermore, students' learning experience is also suspected to be a factor that results in low student numeracy skills in genetics material. Students' learning experience during teaching and learning activities (KBM) plays an important role in the construction of students' ability to think. The implementation of learning activities that are not numeracy-based can cause students' learning experience about numeracy to be lacking. The implementation of mathematics teaching and learning that only provides concepts without being accompanied by contextual linking can make students have difficulty in numeracy. In addition, genetics learning that does not train math skills will make students' numeracy skills low. Thus, students' learning experience needs to be considered because it can affect the achievement of learning outcomes (Heo et al., 2018; Kontaş & Özcan, 2022).

The next factor is the lack of math skills among students. Math skills are needed to solve problems in genetic material. The test questions given require students to be able to apply mathematical skills, such as computing; calculating probabilities and percentages; transforming data into other forms; and calculations using algebraic equations. Thus, students with good math skills will be more likely to perform optimally on numeracy tests, resulting in good numeracy achievement. On the other hand, students with poor math skills will have difficulty working on problems with certain contexts, resulting in low numeracy achievement.

The next factor that is thought to result in the low level of student numeracy skills in genetics material is the lack of mastery of the concept of genetics. AKM type test questions are indeed focused on measuring students' ability to apply mathematical concepts in various contexts, but in the context of genetics, students need to understand genetics concepts in order to be able to solve the problems presented properly. Students who have a good understanding of the concept of

DOI: https://doi.org/10.17509/aijbe.v5i2.49709
e-ISSN 2621-7260

genetics will find it easier to work through the questions that are presented. This is supported by the research of Susantini et al. (2018) who found that students with good mastery of genetics concepts demonstrated high learning outcomes. An example of concept mastery is being able to define terminology in genetics topic. This topic may contain foreign terms that, if not well understood, can easily confuse the definition of the term. These terms include phenotype, genotype, allele, gene, heterozygote, and gamete. Based on the results of the study, there are still students who are mistaken in distinguishing phenotypes and genotypes so that they cannot answer the questions correctly.

Finally, students' unfavorable perceptions of themselves and the genetics topic are thought to be a factor in students' low numeracy skills in genetics material. Cruz & Lumahan (2022) asserted that self-concept can impact student achievement. Students who perceive themselves as incapable of mastering certain material are likely to exhibit unfavorable learning outcomes (Rodríguez et al., 2020). This can apply to genetic material which is often perceived as difficult by students so that students lack confidence in mastering the material. In addition to being perceived as difficult by students, genetics is also considered difficult by teachers and even the ability of teachers in genetics material still tends to be low (Diana & Rachamatulloh, 2017). Genetics topics are considered difficult because they use many foreign terms that are less familiar in everyday life; they apply mathematical principles, so they require good numeracy skills; and the learning materials tend to be complex (Lederman et al., 2014; Ozcan et al., 2014).

CONCLUSION

The level of numeracy skills of students of grade XII SMAN X Bandung on genetic material is still categorized as low. Some factors that are thought to be the cause of this are students' lack of experience with Minimum Competency Assessment (AKM) questions, students' learning experience, students' mathematical ability, and students' mastery of genetics concepts. In addition, unfavorable student perceptions are thought to contribute to low student numeracy.

REFERENCES

Çimer, A. (2012). What makes biology learning difficult and effective: students' views. *Educational Research and Reviews*, *7*(3), 61–71.

Cruz, J. D., & Lumahan, J. M. A. (2022). The learners' academic self-concept and its influence to their academic performance amidst the online learning modality. *Psychology and Education: A Multidisciplinary Journal*, *1*(1), 1-4.

Diana, S., & Rachamatulloh, A. (2017). Genetics concept mastery of high school biology teachers in simeulue archipelago through guided teaching strategy. *International Conference on Mathematics and Science Education, 57*, 195–199.

Garcia-Retamero, R., Sobkow, A., Petrova, D., Garrido, D., & Traczyk, J. (2019). Numeracy and risk literacy: What have we learned so far?. *The Spanish Journal of Psychology, 22*, 1-10.

Gupta, P. K. (2019). Teaching genetics in India: Problems and possible solutions. *Indian Journal Of Genetics and Plant Breeding, 79*(1), 326 – 339.

Heo, D., Anwar, S., & Menekse, M. (2018). The relationship between engineering students' achievement goals, reflection behaviors, and learning outcomes. *International Journal of Engineering Education*, *34*(5), 1634-1643.

Howard, S. J., Woodcock, S., Ehrich, J., & Bokosmaty, S. (2016). What are standardized literacy and numeracy tests testing? Evidence of the domain-general contributions to students standardized educational test performance. *British Journal of Educational Psychology, 87(*1), 108–122.

Kumar, M., & Behera, B. (2022). Influence of home environment on children's foundational literacy

and numeracy skills: A systematic synthesis with India in focus. *Asian Journal for Mathematics Education*, *1*(3), 359–380.

Kontaş, H., & Özcan, B. (2022). Explaining middle school students' mathematical literacy with sources of self-efficacy, achievement expectation from family, peers and teachers. *International Journal of Education and Literacy Studies*, *10*(1), 198-206.

Lederman, N. G., Antink, A., & Bartos, S. (2014). Nature of science, scientific inquiry, and socio-scientific issues arising from genetics: A pathway to developing a scientifically literate citizenry. *Science & Education*, *23*, 285-302.

Muzaki, A., & Masjudin, M. (2019). Analisis kemampuan literasi matematis siswa. *Mosharofa: Jurnal Pendidikan Matematika*, *8*(3), 493–502.

Osman, E., Boujaoude, S., & Hamdan, H. (2017). An investigation of Lebanese G7-12 students' misconceptions and difficulties in genetics and their genetics literacy. *International Journal of Science and Mathematics Education, 15*(7), 1257–1280.

Ozcan, T., Ozgur, S., Kat, A., & Elgun, S. (2014). Identifiying and comparing the degree of difficulties biology subjects by adjusting it is reasons in elemantary and secondary education. *Procedia - Social and Behavioral Sciences*, *116*, 113-122.

Rodríguez, S., Regueiro, B., Piñeiro, I., Estévez, I., & Valle, A. (2020). Gender differences in mathematics motivation: Differential effects on performance in primary education. *Frontiers in Psychology*, *10*, 3050.

Sepriyanti, N., Nelwati, S., Kustati, M., & Afriadi, J. (2022). The effect of 21st – century learning on higher-order thinking skills (HOTS) and numerical literacy of science students in Indonesia based on gender. *Jurnal Pendidikan IPA Indonesia, 11*(2), 314-321.

Susantini, E., Sumitro, S. B., Corebima, A. D., & Susilo, H. (2018). Improving learning process in genetics classroom by using metacognitive strategy. *Asia Pacific Education Review*, *19*(3), 401–411.

Szabo, Z. K., Körtesi, P., Guncaga, J., Szabo, D., & Neag, R. (2020). Examples of problem-solving strategies in mathematics education supporting the sustainability of 21st-century skills. *Sustainability*, *12*(23), 10113.

Tju, M., & Murniarti, E. (2021). Analisis pelatihan asesmen kompetensi minimum. *Jurnal Dinamika Pendidikan*, *14*(2), 110–116.

Teo, P. (2019). Teaching for the 21st century: A case for dialogic pedagogy. *Learning, Culture and Social Interaction, 21*, 170–178.

Umbara, U., & Suryadi, D. (2019). Re-interpretation of mathematical literacy based on the teacher's perspective. *International Journal of Instruction*, *12*(4), 789–806.

Utaminingsih, R., & Subanji, S. (2021). Analisis kemampuan literasi matematika peserta didik pada materi program linear dalam pembelajaran daring. *ANARGYA: Jurnal Ilmiah Pendidikan Matematika*, *4*(1), 28–37.

Acknowledgment

Researcher would like to thank the university which funded this research and the participants who were involved in this research

Authors' Note

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

How to Cite this Article

Andriani, L., Diana, S., & Hidayat, T. (2022). Analysis of students' numeracy skill in genetics topic based on minimum assessment competency. *Assimilation: Indonesian Journal of Biology Education*, *5*(2), 113-118.

DOI: https://doi.org/10.17509/aijbe.v5i2.49709
e-ISSN 2621-7260