International Journal of Education and Teaching Zone, Volume 1 (Issue 2): 08-10 (2022)
DOI: https://doi.org/10.57092/ijetz.v1i2.34

THE JOURNAL OF IJETZ
(International Journal of Education and Teaching Zone)
P-ISSN: 2963-7899 I E-ISSN: 2830-7925
jurnal.yayasannurulyakin.sch.id/index.php/ijetz

The Understanding Mathematical Communication Concepts and Skills: Analysis of the Ability of Prospective Physics Teachers?

Irfan Yusuf[1]*Aminah Zb[2], Edi Rozal[3]
[1]Faculty of Teacher Training and Education, Univesitas Papua, Papua Barat, Indonesia
[2,3]Faculty of Tarbiyah and Teacher Training, UIN Sulthan Tahaha Saifuddin Jambi, Jambi, Indonesia

Article History:
Received: September 13, 2022
Revised: September 25, 2022
Accepted: September 29, 2022
Published: October 08, 2022

Keywords:
Concept Understanding Ability, Mathematical Communication Skills, Maxwell-Boltzman material, Prospective Physics Teacher.

***Correspondence Author:**
i.yusuf@unipa.ac.id

Abstract: The research that has been carried out aims to see the ability to understand mathematical concepts and mathematical communication of students on the Maxwell-Boltzman material for Tadris Physics students, especially students in semester VI. This research is a quantitative descriptive study in which the data collected from the test results and the results of the lecture process at the time of giving the Maxwell-Boltzman material will be analyzed and described and added with a test technique on the cognitive domain in the form of a description test (essay) consisting of 7 test questions, where five questions are for understanding students' mathematical concepts and two questions for technical analysis of students' mathematical communication skills. The data obtained in the quantitative analysis and according to the five categories that have been determined. The facts obtained from the results of the study show that students' ability to understand mathematical concepts in the Maxwell-Boltzman material is in the Good Enough category, and the average mathematical communication ability of students is also in the Good Enough category.

INTRODUCTION

Education in the revolution 4.0 era prioritizes technological changes in the learning process (Defrianti & Iskandar, 2022; Ningsih, 2022), The Physics lecture process is a learning process that has a lot to do with understanding concepts in analyzing and recognizing the universe (Reyza et al., 2022; Sulman, Sutopo, et al., 2021; Sulman et al., 2022). In understanding physics, of course, an understanding of concepts is needed (Goodhew et al., 2019; Parno et al., 2021), and in understanding some physics concepts, mathematical abilities are needed (Rozal et al., 2021; Sulman et al., 2020) which owned by physics students so that it can make it easier for them to understand and apply equations so that they are more effective to understand and analyze. The mathematical abilities possessed by students greatly influence the physics learning process. One of the materials closely related to mathematical mastery is the Maxwell-Bolzan equation material in the statistical physics course. The maxwell-Boltzman equation is a material that is closely related to students' mathematical abilities. Analysis in the form of thinking processes in deriving the Maxwell-Boltzman equation in statistical physics courses is

strongly influenced by students' mathematical abilities. Basic mathematical abilities that can be improved in maximizing student learning outcomes are the ability to understand concepts and mathematical communication skills.

Concept understanding ability is an individual's ability to analyze deeper in the learning process carried out (Mestre et al., 2011; Nehru et al., 2020), and is usually seen from how someone can analyze a problem into an idea in analyzing or providing The solution to the given problem (Reyza et al., 2022; Waldrip et al., 2013), in this case, is to determine the maximum probability of the Maxwell-Boltzman particle. Understanding mathematical concepts are believed to be very important and can have a tremendous impact on improving student learning outcomes, especially on the Maxwell-Boltzman material. The lecture process emphasizes the focus on the ability to understand mathematical concepts, which are indirectly very important for students. The ability of mathematical understanding makes students able to find ideas and provide solutions (Meiliani et al., 2021; Putra et al., 2021; Sulman et al., 2020) to the derivation of the Maxwell-Boltzman equation that is being analyzed, which ultimately makes it easier for students to be able to easily find ways to solve the Maxwell-Biltzman equation for analysis so that the lecture process can run optimally. In addition to mathematical understanding, of course, students' basic mathematical abilities are also needed so that they can improve their learning understanding, namely mathematical communication skills.

Communication skills in lectures are needed as a companion to students' complete understanding of mathematical concepts. Mathematical communication skills can support students' understanding of concepts so that they become students who can truly be in line with global changes, namely students who not only understand the material well but are able to explain the material or ideas they have to others and are also able to present ideas that have been developed. Obtained both in writing and orally so that the material or ideas that have been understood and possessed can be conveyed properly and correctly. Mathematical communication skills will be an indication of students' affective and psychomotor abilities and, at the same time, be a statement that learning is not only about understanding the material for yourself but also about how to convey ideas and ideas so that they can be accepted and used by both individuals and others, especially in equation for Maxwell-Boltzmann material.

In order to understand the derivation of the Maxwell Boltzman formula, usually, the direction in the lecture is how to understand the final material, namely how to get the Maxwell-Boltzman equation only, so that students' ability to understand mathematical concepts and mathematical communication is a bit neglected. Changes in the process and objectives of lectures should change and can be directed to how to form students who have the ability in both the cognitive and the affective and psychomotor domains. Mathematical communication can trigger students to be more confident in expressing their understanding of the material they have. The growth of communication skills and understanding of student concepts can indirectly increase students' self-confidence and motivate learning in understanding the Maxwell-Boltzman equation to be deeper and maximal. Mathematical communication motivates students to find additional information

so that the analyzed Maxwell-Boltzman material can be reviewed better with more references; thanks to mathematical communication, students will also be able to connect and relate several mathematical equations in physics so that they are able to relate one equation to another. Others, so that the primary goal of deriving the Maxwell-Boltzman equation can be achieved more easily. The description above shows the importance of understanding student mathematical concepts and student mathematical communication in solving the Maxwell-Boltzman equation so that it is believed to easily maximize the statistical physics lecture process.

The process of statistical physics lectures, especially to describe the Maxwell-Boltzman Equation in statistical physics, requires an understanding of concepts and good mathematical communication. This is because the statistical physics course in the Maxwell-Boltzman material is closely related to students' mathematical abilities, especially the ability to understand mathematical concepts and mathematical communication in maintaining the effectiveness of the lecture process. The process of statistical physics lectures, especially on the Maxwell-Boltzman material, of course, is greatly influenced by how to understand the basic concepts of some physics courses and also how the basic mathematical abilities of students are both how to communicate mathematically to students and of course how students understand the concepts of Maxwell-Boltzman material. The learning process that requires the ability to understand mathematical concepts and mathematical communication researchers have done The above explanation is the basis and indication for us researchers in researching investigating students' conceptual understanding abilities and student communication on the Maxwell-Boltzman material which is part of the material in statistical physics lectures, to be able to see how the student's actual ability to understand and explain the Maxwell-Botzman equation, especially to see the maximum probability of a classical particle.

METHOD

The type of research that has been used in this research is descriptive quantitative, which was conducted in the sixth semester of the Physics Study Program of UIN Sulthan Thaha Saifuddin Jambi in the 2021/2022 academic year. In the process of observing this research, the aim is to be able to present a fact from the data that has been obtained in the study (De Silva, 2014; Lodico, 2010). The research process that has been carried out is expected to be able to present comprehensive data on the basic mathematics skills possessed by physics tadris students. The basic mathematical abilities that are observed, analyzed, and explored in this study are trying to see the mathematical communication skills of students when studying the Maxwell-Boltzman equation material being carried out or being studied in statistical physics courses. As for collecting data, the research process that has been carried out is by using the description test questions that have been presented. In the research process that has been carried out, the instrument for testing students' mathematical abilities and students' communication skills in the form of mathematical abilities of them consists of 7 questions for each category, where five

questions are tested to see students' conceptual understanding and two questions to see special students' mathematical communication skills. In the Maxwell-Boltzman material.

The description test is given to students who take statistical physics courses, especially those who study the Maxwell-Boltzman material. In the research process that has been carried out, the instrument questions used are validated by experts so that the questions used are really appropriate to measure the understanding of mathematical concepts and students' mathematical communication skills in describing the Maxwell-Boltzmann equation. Process analysis The data on the results of the students' learning outcomes test on the Maxwell-Boltxman material were then analyzed and analyzed descriptively to determine the ability to understand students' mathematical concepts and students' mathematical communication skills which were distributed were then compared in the form of achievement of predicates on each measured mathematical ability, namely ability to understand mathematical concepts and skills to understand mathematical concepts. The research process that has been carried out using a Likert scale where all the value processes that have been obtained by students will be categorized with predetermined categories and can be seen in table 1.

Table 1. Scoring category Student grade

No	Percentage	Category
1	81-100	Very good
2	61-80	Good
3	41-60	Pretty Good
4	21-40	Not Good
5	0-20	Very Not Good

RESULT AND DISCUSSION

In the research that has been carried out, there are several facts that researchers can describe in this study, namely based on the analysis of student learning outcomes from 7 regarding the ability to understand students' mathematical concepts and the ability of student's communication skills, some important information is obtained that can inform students' abilities in understanding Maxwell's equations. - Boltzman. The research that has been carried out has described some understandings that can conclude a situation or capacity possessed by students. Mathematical understanding of understanding mathematical concepts and also students' mathematical skills that have been observed after the research is conducted and reviewed in the lecture process when the maxwell-Boltzaman equation derivation is carried out, which has been tested by all students who take statistical physics courses, namely physics tadris students with the results getting some of the facts that are obtained are seen in the Profile of Students' Mathematical Concept Understanding Ability and mathematical skills of tadris physics students. The results were obtained starting from the value taken from actual data as a test of the ability to understand concepts and student skills. The results of the assessment of students' understanding of mathematical concepts after answering 5 test questions on the Maxwell-Boltzman material can be seen in Table 2.

Table 2. Understanding mathematical concepts

No	Percentage	Total students	Category
1	81-100	5	Very good
2	61-80	6	Good
3	41-60	18	Pretty Good
4	21-40	2	Not Good
5	0-20	0	Very Not Good

The research process for students' conceptual understanding abilities obtained data on physics students' understanding of the average criteria ability in the pretty good category. Based on Table 2, we can see that the students whose ability to understand mathematical concepts is very good are five people, then six students are in a good category, 18 students have the ability to master mathematical concepts quite well, while two students are in Not Good category. And there are no students (0 people) who are in the very bad category. The research process resulted in the fact that classically, students' ability to understand mathematical concepts was, on average, in a pretty good category in terms of the five categories that the researchers determined. This means that a student's ability to understand mathematical concepts classically falls into the pretty good category.

A good understanding of the concepts students possess can indirectly make it easier for students to explore further understanding. A good understanding of concepts can encourage students' enthusiasm to further examine the material provided (Mestre et al., 2011; Stoen et al., 2020). understanding a concept, several supporting references are needed to provide information to solve statistical physics equations. Understanding the concept will encourage students to be able to correct themselves for the ideas that have been made; in other words, it will be an effort to convince themselves to understand a better teaching material (Meiliani et al., 2021; Zb, Novalian, Ananda, et al., 2021; Zb, Novalian, Rozal, et al., 2021). Students who have a good understanding of mathematical concepts will easily adapt or work on the problems being analyzed in statistical physics courses in general and the Maxwell-Boltzman equation in particular in every lecture process.

The questions used to measure the ability to understand mathematical concepts using essay description questions, which amount to 5 questions. The questions given or referred to are the content of mathematical problems that play a role in deriving students' Maxwell-Boltzman mathematical equations. Understanding mathematical concepts is believed to make it easier for students to understand mathematical problems and concepts in statistical physics, especially the Maxwell-Boltzmann equation. In addition to the ability of mathematical concepts, this study also observed how students' mathematical communication skills in the Maxwell-Boltzman material. It is believed that students' mathematical communication skills also play an important role in making it easier to solve equations in the Maxwell-Boltzman material, as well as increasing student skills according to the 4.0 industrial era needed today. The data obtained from the research process that has been carried out on students' mathematical communication skills in detail based on categories can be seen in Table 3.

Table 3. Analysis of mathematical communication understanding

No	Percentage	Total students	Category
1	81-100	4	Very good
2	61-80	6	Good
3	41-60	16	Pretty Good
4	21-40	5	Not Good
5	0-20	0	Very Not Good

Some general facts that have been obtained by researchers from the results of the research process that has been carried out, namely regarding the mathematical communication skills of physics students, it was found that physics students were based on the average criteria in a fairly good category when viewed from the categories set in the table. 1. The results of the research on students' skill skills have been shown. Based on Table 3, it can be described as follows where we can see that students with very good mathematical communication skills are four people. Six students are in the good category, 16 students can master mathematical concepts quite well, while five are in the Not Good category. No students (0 people) are in the Very Not Good category. The research process resulted in that classically, students' mathematical communication skills were, on average, in a pretty good category when viewed from the five categories that the researchers determined.

The description of the data that has been described above shows that the student's communication skills are not yet at the maximum stage, but when viewed on average, students' mathematical communication skills are classically included in a pretty good category. Students' communication skills are quite good; of course, it is news that students' communication skills still have to be improved, at least in the good category, so that students' abilities can support an effective and maximum lecture process. The questions used to measure mathematical communication skills using essay description questions, which amount to 2 questions. The questions given or referred to are the content of mathematical problems in the Maxwell-Boltzmann equation that play a role in deriving mathematical equations. The number of questions given is only two questions. However, for each question, students are expected to be able to explain the Maxwell-Boltzman understanding more concretely, thereby increasing students' abilities to add insight which is, of course, in line with the government program, namely making good students from several aspects of life (Sulman, Tanti, et al., 2021; Zb et al., 2020). Mathematical communication skills are very necessary to be instilled in students so that students become individuals who are truly qualified and in accordance with the times (Rozal et al., 2021; Sulman et al., 2020). Mathematical communication skills are believed to make it easier for students to understand mathematical problems and concepts in statistical physics. In addition to mathematical communication skills, this study also observes students' mathematical connection skills, which are believed to also play an important role in making it easier to solve Maxwell-Boltzmann equations.

The explanations that the researchers have expressed regarding critical thinking skills above certainly show and reflect the research process that produces a very important fact in realizing students who are truly qualified and can meet the demands of the times, whereas classically, where mathematical critical thinking skills are needed.

Owned by students, on average, they are in the pretty good category, and for understanding the concept of students, they are in the pretty good category. The ability to understand mathematical concepts and also students' mathematical communication skills in solving mathematical problems in describing students' Maxwell-Boltzman equations is believed to be able to increase the effectiveness of physics tadris students in understanding Maxwell-Boltzman material better and at the same time to understand problems that exist in statistical physics in general. The ability to understand mathematical concepts and communication skills has a significant role in shaping changes in students or prospective physics education teachers who are professional and are believed to have a significant impact in solving the Maxwell-Boltzman material equations and can improve student learning outcomes to be maximal and effective.

CONCLUSION

Based on the explanation, based on the understanding of mathematical concepts, mathematical communication, mathematical connections, problem-solving, critical thinking, and creative thinking, 31 students were in the pretty good category. This means that the actual ability of students still needs improvement and improvement. Research improvements for future researchers should pay more attention to essential indicators in the statistical physics lecture process and must review the questions used that have a standard in the assessment of each category.

REFERENCES

De Silva, E. (2014). Cases on research-based teaching methods in science education. In *Cases on Research-Based Teaching Methods in Science Education*. https://doi.org/10.4018/978-1-4666-6375-6

Defrianti, D., & Iskandar, I. (2022). The Mastery of Teacher Emotional Intelligence Facing 21st Century Learning. *International Journal of Educationa and Teaching Zone*, *1*(1), 50–59.

Goodhew, L. M., Robertson, A. D., Heron, P. R. L., & Scherr, R. E. (2019). Student conceptual resources for understanding mechanical wave propagation. *Physical Review Physics Education Research*, *15*(2), 20127. https://doi.org/10.1103/PhysRevPhysEducRes.15.020127

Lodico, M. . S. D. & V. K. (2010). Methods in Educational Research: From Theory to Practice, 2nd Edition. In *The Canadian Journal of Action Research* (Issue 3).

Meiliani, M., Tanti, T., & Sulman, F. (2021). Student Resources On Newton's Lawa Concepts Reviewing From Gender: Identification Using Open-Ended Question. *Indonesia Journal of Science and Mathematics Education*, *04*(November), 324–332. https://doi.org/10.24042/ijsme.v4i3.10177

Mestre, J. P., Docktor, J. L., Strand, N. E., & Ross, B. H. (2011). Conceptual Problem Solving in Physics. In *Psychology of Learning and Motivation - Advances in Research and Theory* (Vol. 55). Elsevier Inc. https://doi.org/10.1016/B978-0-12-387691-1.00009-0

Nehru, Riantoni, C., Rasmi, D. P., Kurniawan, W., & Iskandar. (2020). "Knowledge in

pieces" view: Conceptual understanding analysis of pre-service physics teachers on direct current resistive electrical circuits. *Journal for the Education of Gifted Young Scientists*, *8*(2), 723–730. https://doi.org/10.17478/jegys.695853

Ningsih, F. N. (2022). Analysis of Students ' Concession Understanding Ability in Solving Physics Concepts. *International Journal of Educationa and Teaching Zone*, *1*(1), 25–33.

Parno, P., Mufidah, J., Diantoro, M., & Ali, M. (2021). Building conceptual understanding of students on laws of Newton through argument-driven inquiry. *AIP Conference Proceedings*, *2330*(March). https://doi.org/10.1063/5.0043127

Putra, M. I. J., Junaid, M., & Sulman, F. (2021). The Ability of the Question and Answer (Q&A) Method with the Help of Learning Videos against Student Learning Outcomes amid the Covid-19 Pandemic. *EDUKATIF: Jurnal Ilmu Pendidikan*, *3*(5), 2160–2169. https://doi.org/https://doi.org/10.31004/edukatif.v3i5.768

Reyza, M., Taqwa, A., Sulman, F., & Faizah, R. (2022). College Students ' Conceptual Understanding of Force and Motion : Research Focus on Resource Theory College Students ' Conceptual Understanding of Force and Motion : Research Focus on Resource Theory. *Journal of Physics: Conference Series*. https://doi.org/10.1088/1742-6596/2309/1/012073

Rozal, E., Ananda, R., Zb, A., Fauziddin, M., & Sulman, F. (2021). The Effect of Project-Based Learning through YouTube Presentations on English Learning Outcomes in Physics. *AL-ISHLAH: Jurnal Pendidikan*, *13*(3), 1924–1933. https://doi.org/10.35445/alishlah.v13i3.1241

Stoen, S. M., McDaniel, M. A., Frey, R. F., Hynes, K. M., & Cahill, M. J. (2020). Force concept inventory: More than just conceptual understanding. *Physical Review Physics Education Research*, *16*(1), 10105. https://doi.org/10.1103/PhysRevPhysEducRes.16.010105

Sulman, F., Sutopo, S., & Kusairi, S. (2021). FMCE-PHQ-9 Assessment with Rasch Model in Detecting Concept Understanding , Cheating , and Depression amid the Covid-19 Pandemic. *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *6*(2), 297–309. https://doi.org/10.24042/tadris.v6i2.9273

Sulman, F., Tanti, T., Habibi, M., & Zb, A. (2021). Pengaruh Media Animasi Berkarakter Islami Terhadap Hasil Belajar Pengetahuan Bumi dan Antariksa. *Edumaspul: Jurnal Pendidikan*, *5*(1), 135–146. https://doi.org/10.33487/edumaspul.v5i1.1044

Sulman, F., Taqwa, M. R. A., Aminah Zb, A. Z., Rafzan, R., & Fikri, A. (2020). The Effect of Mathematical Connections on the Mastery of Probability Material. *Edumatika : Jurnal Riset Pendidikan Matematika*, *3*(2), 147–157. https://doi.org/10.32939/ejrpm.v3i2.645

Sulman, F., Yuliati, L., Kusairi, S., & Hidayat, A. (2022). Hybrid Learning Model : Its Impact on Mastery of Concepts and Self- Regulation in Newton ' s Second Law Material. *Kasuari: Physics Education Journal*, *5*(1), 65–74. https://doi.org/https://doi.org/10.37891/kpej.v5i1.273

Waldrip, B., Prain, V., & Sellings, P. (2013). Explaining Newton's laws of motion:

Using student reasoning through representations to develop conceptual understanding. *Instructional Science*, *41*(1), 165–189. https://doi.org/10.1007/s11251-012-9223-8

Zb, A., Novalian, D., Ananda, R., Habibi, M., & Sulman, F. (2021). *DISTANCE LEARNING WITH STEAM APPROACHES: Is Effect On The Cognitive Domain?* *6*(2), 129–140.

Zb, A., Novalian, D., Rozal, E., Sulman, F., & Habibi, M. (2021). STEM Approach in Online Lectures: How Does it Contribute to Cognitive Aspects? *Indonesian Journal of Science and Education*, *5*(2), 88–97. https://doi.org/10.31002/ijose.v5i2.4365

Zb, A., Setiawan, M. E., & Sulman, F. (2020). Pengaruh E-Learning Berbasis Schoology Berbantuan WhatsApp Group terhadap Hasil Belajar Ditengah Pandemi Covid-19. *Al-Khidmah*, *3*(2), 55–60. https://doi.org/10.29406/al-khidmah.v3i2.2282