

Analysis of Numerical Ability Students on Chemical Equilibrium

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Abstract

This study aims to determine the level of numerical ability in class XI students of SMA Negeri 1 Parigi Kab. Parigi Moutong. This research was carried out from January to March 2023. The research method used is quantitative descriptive. Data analysis using descriptive statistics. The sampling technique is random sampling. The research instrument used was a description numerical ability test. The results showed that the level of students' numerical abilities on the indicators of performing mathematical calculations was in the low category, with a percentage of 28.44%. The logical thinking indicator obtained low category results with a percentage of 28.24%. The problem-solving indicator obtained a very low category result of 11.45%. On indicators recognising patterns and relationships between numbers, results with a percentage are in the very low category. Data on the results of students' numerical abilities at SMA Negeri 1 Parigi are categorised as very low. The results of this study are expected to be a source of information regarding the numerical ability of class XI students in chemical equilibrium material.

Keywords: *Ability; Numerical; Chemical equilibrium; Chemical*

I. Introduction

Education is an effort to influence students to perform better actions through activities, guidance, and valuable teaching that fosters independence in their lives. This change demands students to move towards maturity. Education is one of the most crucial issues for a nation as it measures its progress and cultivates individuals' thinking abilities for a better life. The current challenges faced by the world of education revolve around the low level of learning processes students attain regarding the quality of learning outcomes [1]. Education itself aims to optimise and develop abilities to enhance the quality of life and the dignity of Indonesian people [2]-[3].

Learning is a process of interaction between educators and learners to acquire knowledge from education learners. This learning process can take place within or outside the educational environment. During this learning process, information is exchanged between teachers and students [4]-[5]. The objective of learning is to enable learners to master the taught material and what they have acquired from their learning outcomes. Chemistry is a natural science that studies matter, including its structure, composition, properties, and changes, as well as its energy [6].

Numerical ability refers to the accuracy and speed in using essential mathematical functions. The numerical ability has four indicators: mathematical calculations, logical thinking skills, problem-solving abilities, and sharpness in identifying numerical patterns and their relationships. Mathematical calculations involve performing basic calculations, such as addition, subtraction, logarithms, square roots, and so on [7]. Numerical ability is the student's capacity to solve arithmetic problems, number series, letter series, numerical logic, and numerical word problems [8].

Chemistry is a branch of natural science that explicitly studies matter's composition, characteristics, and changes. Almost everything in nature is composed of matter, making it possible to be studied by understanding the concepts within the field of chemistry. Understanding these concepts in chemistry forms the basis for a correct understanding of other, more complex concepts [4]. Chemistry has several characteristics as follows: 1) Chemistry is mainly abstract, 2) The chemistry studied is a simplification of the actual phenomena, 3) The subject matter of chemistry is sequential and rapidly evolving, 4) Chemistry is not merely about solving problems, 5) The workload in the study of chemistry is extensive [9].

Chemical equilibrium is one of the main topics in the field of chemistry. The topic of chemical equilibrium is covered in the first semester (odd semester) of the 11th grade in high school. The content of chemical equilibrium includes (1) dynamic equilibrium, (2) homogeneous and heterogeneous equilibrium, (3) equilibrium constants, (4) equilibrium shifts, (5) quantitative relationships among components in equilibrium reactions, and (6) chemical equilibrium in industrial processes. This article aims to describe the level of numerical ability of students in the topic of chemical equilibrium. Chemistry is one of the subjects that are less favoured by most high school students [10]. This is because chemistry is perceived as a difficult subject, sometimes discouraging students from further studying chemistry. The perception that chemistry is difficult leads to a lack of motivation among students to learn chemistry [11].

II. Method

This research is a quantitative descriptive study. The researcher employs the quantitative descriptive research method to depict the level of numerical ability among students on chemical equilibrium. The

quantitative approach calculates the students' scores when answering the numerical ability test. This study is a survey research, specifically an analytical survey, which aims to test the relationship between variables by utilising statistical calculations with specific statistical formulas [12]. The population for this research consists of all 240 students in the 12th-grade science stream. The sample size is 127 individuals. The study was conducted from January to March 2023 at SMA Negeri 1 Parigi. The instrument used in this research is an essay test assessing numerical ability, comprising 30 open-ended questions. The data analysis technique involves calculating the mean and standard deviation.

III. Results and Discussion

This research indicates that students' numerical ability in chemical equilibrium is significantly low. The percentage for each indicator of numerical ability, namely mathematical calculation, logical thinking, problem-solving, and recognising patterns and relationships among numbers, is remarkably low. This implies that students face considerable challenges in performing mathematical calculations accurately, demonstrating logical thinking skills, effectively solving problems, and identifying patterns and relationships among numbers. These findings emphasise the need for interventions and targeted instructional strategies to enhance students' numerical proficiency, specifically in chemical equilibrium.

a. Mathematical calculations

The data obtained from the analysis of numerical ability in mathematical calculations is presented in Table 1.

Table 1. Numerical Ability in the Mathematical Calculation Indicator

Category	F	Percentage
Very Low	61	13,91
Low	66	28,44
Moderate	0	0
High	0	0
Very High	0	0
Total	127	42,35

Based on the data analysis results, an overview of the numerical ability to perform mathematical calculations on chemical equilibrium. It can be observed that the analysis of numerical ability in the aspect of mathematical calculations among students on the topic of chemical equilibrium falls under the low category. These results indicate that students need a higher numerical ability in performing calculations. In this indicator, the researcher analysed students' computational skills, including their

understanding of basic calculations such as addition, subtraction, multiplication, division, and square roots. The analysis of numerical ability in mathematical calculations yielded a percentage of 28.44%, falling under the low category.

This is since the students in the school can be considered incapable or uninterested in problems related to numbers, resulting in their low level of reasoning in calculations. This aligns with the opinion stated by [13], which suggests that students may need higher computational skills to achieve one of the indicators: mathematical calculation. [14] emphasises the importance of speed and accuracy in basic calculations to numerical ability. The indicator of mathematical calculations is presented in all the questions as it is closely related to assessing students' numerical skills.

b. Logical Thinking

Based on the data obtained from the analysis of numerical ability in the aspect of logical thinking is presented in Table 2.

Table 2. Numerical Ability in the Logical Thinking Indicator

Category	F	Presentage
Very Low	61	13,44
Low	66	28,24
Moderate	0	0
High	0	0
Very High	0	0
Total	127	41,68

Based on the data analysis results, an overview of the numerical ability to perform mathematical calculations on the topic of chemical equilibrium is provided. Based on Figure 2, it can be observed that the analysis of numerical ability in the aspect of logical thinking among students in the topic of chemical equilibrium falls under the low category. These results indicate that students have a low level of numerical ability in rational thinking, as evidenced by the significant percentage (28.24%) of students classified as having low numerical ability.

This is because the students in the school have not yet developed the ability to use reasoning to find solution concepts in the given test, even though the problems, in this case, do not require complex calculations. This is consistent with the findings of previous research [13], which suggests that students who struggle with reasoning in finding solution concepts in problems, even if they do not involve difficult calculations, are likely to have low logical thinking abilities. In logical thinking, students not only need the skills to perform mathematical calculations but also require an understanding of mathematical concepts. The ability to perform arithmetic operations alone does not guarantee success

in solving other calculation problems. To successfully solve such problems, students must be able to explain, organise, and logically and systematically connect the cause and effect of a problem. This requires students to have a solid grasp of all the fundamental mathematical concepts underpinning the calculation problems related to the chemistry topic [15].

c. Problem-solving

The data obtained from the analysis of numerical ability in the aspect of problem-solving is presented in Table 3.

Table 3. Numerical Ability in the Problem-Solving Indicator

Category	F	Percentage
Very Low	67	11,45
Low	60	25,33
Moderate	0	0
High	0	0
Very High	0	0
Total	127	36,78

Based on the data analysis, an overview of the numerical ability in problem-solving regarding the topic of chemical equilibrium. It can be observed that the analysis of numerical ability in problem-solving aspect among students regarding the topic of chemical equilibrium falls under the "Very Low" category. This result indicates that students have a low level of numerical ability in problem-solving. Specifically, 11.45% of students were classified as having low numerical ability in problem-solving aspect.

The low level of numerical ability in problem-solving among students at SMA Negeri 1 Parigi can be attributed to their inability to analyse problem situations presented in the form of story problems and their difficulty in applying the correct concepts or principles taught in the subject matter. According to [13], story problems are designed to assess students' accuracy in analysing problem situations, indicating that the students' accuracy level is low. In this aspect, students are expected to have the ability to comprehend a story problem and then formulate it into mathematical equations or expressions. Therefore, the ability to think abstractly serves as the foundation for solving calculation problems presented in the form of stories.

d. Recognising patterns and relationships among numbers

Based on the data analysis results, the numerical ability to recognise patterns and relationships among numbers is presented in Table 4.

Table 4. Numerical Ability in Recognising Patterns and Relationships Among Numbers

Category	F	Percentage
Very Low	99	12,53
Low	28	23,37
Moderate	0	0
High	0	0
Very High	0	0
Total	127	35,9

Based on the data analysis, a visual representation of the numerical ability to recognise patterns and relationships among numbers in chemical equilibrium. It can be observed that the analysis of students' numerical ability to recognise patterns and relationships among numbers on the topic of chemical equilibrium falls under the category of Very Low. These results indicate that students must still develop a high numerical ability to recognise patterns and relationships among numbers. The percentage of students with low numerical ability in this aspect is 12.53%.

Most students still need clarification when answering the questions, as they cannot connect multiple numbers or draw conclusions from their own work. This test is designed to assess students' intelligence in solving problems related to a series of numbers. If students cannot conclude a set of numbers, it can be said that they have yet to achieve the indicator of recognising patterns and relationships among numbers [13]. This indicator can be defined as the ability to analyse mathematical problems reflected in sequences and series. The required skill is analysing the most logical and consistent form of the numbers presented in the problem. The ability to recognise patterns and relationships among numbers also significantly impacts problem-solving. In essence, the main purpose of the ability to recognise number patterns is to train students' reasoning skills in analysing problems [15].

IV. Conclusion

Based on the research findings, it can be concluded that the percentage of numerical skills concerning the topic of chemical equilibrium in each indicator is as follows: the numerical ability in performing mathematical calculations has a low category with a percentage of 28.44%. The numerical ability in logical thinking is a low category, with a percentage of 28.24%. The indicator of problem-solving ability has a very low category, with a percentage of 11.45%. The numerical ability to recognise patterns and relationships among numbers has a very low category, with a percentage of 12.35%. Based on the data, it can be observed that the indicator with the highest number of students falling in the "very low" category is the numerical ability to recognise patterns and relationships among numbers.

References

- [1] M. Arifin, "*Ilmu Pendidikan Islam*," Jakarta, Bumi Aksara, 2000.
- [2] Astuti dan Leonard, "Peran Kemampuan Komunikasi Matematika Terhadap Prestasi belajar Matematika Siswa," *Jurnal Pendidikan Berkarakter*, vol. 2, no. 2, pp. 102-110, 2015.
- [3] A. Sukmafani, M. Munzil, dan I. J. Fitriyah, "Development of teaching material with the creative problem-solving model using mobile learning application," *Journal of Disruptive Learning Innovation (JODLI)*, vol. 2, no. 2, pp. 124-135, 2021.
- [4] K. Mustapa, A. K. Ahyar, R. Ratman, dan M. Magfirah, "The effect of using google classroom and whatsapp group applications on students' interest and learning outcomes in chemistry during the covid-19 pandemic," *Journal of Disruptive Learning Innovation (JODLI)*, vol. 4, no. 1, hal. 32-42, 2023.
- [5] N. Amrilizia, H. Habiddin, dan M. F. Marsuki, "Improving students' critical thinking skills using e-modules-contextual teaching and learning (CTL) on the interaction of living organisms with their environment," *Journal of Disruptive Learning Innovation (JODLI)*, vol. 3, no. 2, pp. 65-82, 2022.
- [6] R. Suryani, "*Strategi Pembelajaran Kimia*," Yogyakarta, Graha Ilmu, 2008.
- [7] S. Sitriani, K. Kadir, L. Arapu, dan L. Ndia, "Analisis Kemampuan Numerik Siswa SMP negeri di Kota Kendari Ditinjau dari perbedaan Gender," *Jurnal Pendidikan Matematika*, vol. 10, no. 2, pp. 161-171, 2019.
- [8] N. Oktaviana, "Kemampuan Numerik Mahasiswa Pendidikan Matematika IKIP PGRI Pontianak," *Jurnal Pendidikan*, vol. 2, no. 1, pp. 79-93, 2019.
- [9] B. Zuhroti, S. Marfu'ah, dan M. S. Ibnu, "Identifikasi Pemahaman Konsep Tingkat Representasi Makroskopik, Mikroskopik dan Simbolik Siswa Pada Materi Asam Basa," *Jurnal Pembelajaran Kimia*, vol. 3, no. 2, pp. 44-49, 2018.
- [10] I. W. Subagia, "Paradigma Baru Pembelajaran Kimia SMA," Prosiding Seminar Nasional MIPA, Singaraja, Universitas Pendidikan Ganesha, pp. 152-163, 2014.
- [11] Budriawan, "Hubungan Motivasi belajar dengan Hasil Belajar pada mata Pelajaran Kimia," *Jurnal Pendidikan Kimia Indonesia*, vol. 2, no. 3, pp. 103-111, 2019.
- [12] Sugiyono, "*Quantitative, qualitative, and R&D research methods*," Bandung, Alfabeta, 2019.
- [13] W. Isworo, D. Sunarno, dan D. Wahyuningsi, "Hubungan Antara Kreativitas Siswa dan Kemampuan Numerik Dengan Kemampuan Kognitif Fisika Siswa SMP Kelas VIII," *Jurnal Pendidikan Fisika*, vol. 2, no. 2, pp. 35-39, 2014.
- [14] A. Irawan, "Peranan Kemampuan Numerik dan Verbal dalam Berpikir Kritis Matematika Pada Tingkat SMA," *Jurnal Pendidikan Matematika*, vol. 6, no. 2, pp. 121-130, 2016.
- [15] S. Jelatu, M. E. Mon, dan S. San, "Relasi Antara Kemampuan Numerik Dengan Prestasi Belajar Matematika," *Jurnal Pendidikan Matematika*, vol. 10, no. 1, pp. 1-18, 2019.