

Metacognitive writing task strategy to improve concept mastery and communication skills of junior high school students in the topic of light and optical instruments

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Abstract

The purpose of this study was to improve students' concept mastery and communication skills by implementing metacognitive writing task strategies and analyzing the correlation between students concept mastery and communication skills. The research method used is a quantitative quasi-experimental design method with a non-equivalent control group design research design. The results showed that students in the experimental class experienced an increase in mastery of concepts in the moderate category, namely $<g>=0.542$. Meanwhile, students in the control class experienced an increase in mastery of concepts in the low category, namely $<g>=0.272$. Students' communication skills have increased even though in the low category, namely $<g>=0.261$. There is a significant relationship between mastery of concepts and communication skills, the strength of the relationship between the variables of mastery of concepts and communication skills is 0.758 which falls into the category of strongly correlated. The conclusion obtained through this study is that writing task metacognitive strategies in learning is proven to improve students' mastery of concepts and communication skills.

Keywords: *Writing Task Metacognitive · Concept Mastery · Communication Skills · Light and Optical Instruments*

INTRODUCTION

Light and optical devices are one of the science concepts that are often found in the application of everyday life and are known from the beginning of student development, but students' mastery of concepts is still low (Kaewkhong et.al., 2010), (Sutopo, 2014). One important aspect of the objectives of learning science in schools is for students to understand study material (concepts, principles, laws, theories) in a meaningful way to explain phenomena in everyday life (Sutopo, 2014). Mastery of concepts is the basis for students to build insight and demonstrate learning outcomes (Johnson & Johnson, 1998). From this description it can be concluded that concept mastery is one of the most important parts of learning activities that affect learning outcomes.

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At the elementary level students assume that light is a light source that gives effects such as light (Ouattara & Boudaoné, 2012). At the junior high school level students think that light is left behind in the mirror when reflection occurs and the lens must be intact in order to form an image (Sheftyawan & Lesmono, 2018). At the high school level students experience problems using a ray diagram to determine the location of the shadow of an object in the water (Kaewkhong et.al., 2010). In college, students have difficulty understanding the basic concepts of geometric optics (Sutopo, 2014). Therefore, mastery of the concept of light and optical devices should receive attention from an early age so that students do not experience difficulties or serve as a support for mastering the concept when continuing to discuss light and optical devices at the next level which of course has a more detailed discussion than the previous level.

In the school environment, students will not be separated from a communication process. Communication is a way for students to show pleasure in talking, socializing, and working with others (Kemdikbud, 2020). Students will continue to communicate to seek information, to ask questions and be active when learning activities take place. In the learning process it is said that the communication process refers to the process of delivering messages from someone as a source of messages (teachers) to recipients of messages (students) (Sumantri, 2015). The better the students' communication skills, the better the learning activities. Conversely, the worse the communication skills, the worse the learning activities will be (Maryanti et.al., 2012). Active learning can be carried out well if students have communication skills (Slavin, 2018).

Communication can be done orally or in written form. Students' skills in communicating in writing help them transfer and present knowledge consistently and correctly so that students are not mistaken in abstracting the information they get, and also skills in communicating in writing help students understand some of the science material that is abstract in nature (Yusefni & Sriyanti, 2016). This research will discuss communication skills through writing. The process of writing is closely related to the process of reading. A person will not be able to write well if he doesn't read a lot, so writing activities in learning become a very solution to increase interest in reading which is low in Indonesia. If students are indirectly assigned to write something true, then students will read from various literature to get the writing they need.

There are still problems related to students' communication skills which are classified as not optimal. Kamaruzzaman's research (2016) revealed the results of the analysis in the form of students' interpersonal communication skills in the sufficient category (47.15%) (Kamaruzzaman, 2016). Likewise, Muslih, et al., (2015) found that students' communication skills were sufficient (66.77%) (Muslih et.al., 2015). Students' ability to ask questions is in the sufficient category (43.75%), with an indication that some students are still embarrassed to provide responses and ask questions when they encounter different answers from the results of discussions with other groups (Wati et.al., 2019). Because students' communication skills are not yet optimal, an effort is needed to improve students' communication skills.

To overcome the problems that exist in the field, the authors are interested in conducting experiment-based research by implementing metacognitive writing task learning strategies during learning and analyzing their effects on students' mastery of concepts and communication skills, if these learning strategies are proven to improve students' mastery of concepts and communication skills, then educators can try to implement this strategy in learning, especially in physics learning so that the learning process becomes more effective.

Through this strategy students are given writing assignments with the addition of a metacognitive aspect which means writing assignments are not only about the material that has been taught but also related to students' self-knowledge of learning, so that it is hoped that it can help students to identify what they really don't understand, the difficulties they face, and others regarding learning and himself, and indirectly become a student's self-evaluation of every lesson he has participated in, because not all students have the same problems or constraints in learning. Through this writing activity it is hoped that students' written communication skills can improve.

In addition to this strategy there is also feedback from the teacher to students. By providing feedback from the *metacognitive writing task activities* carried out by the teacher to each student it is hoped that it can improve students' mastery of concepts. This study aims to determine the increase in students' mastery of concepts and communication skills in light and optical devices by implementing *metacognitive writing task strategies* and to find out whether there is a relationship between concept mastery and students' communication skills.

This study aims to determine the increase in students' mastery of concepts and communication skills in light and optical devices by implementing a metacognitive writing task strategy. In addition, this study also aims to describe the relationship between mastery of concepts and students' communication skills.

To overcome the problems that exist in the field, the authors are interested in conducting experiment-based research by implementing metacognitive writing task learning strategies during learning and analyzing their effects on students' mastery of concepts and communication skills, if these learning strategies are proven to improve students' mastery of concepts and communication skills, then educators can try to implement this strategy in learning, especially in physics learning so that the learning process becomes more effective.

METHODS

The research method used in this study is the quasi-experimental design method or quasi-experimental. The research design used was the nonequivalent control group design, in which the experimental and control groups were not randomly selected (Sugiyono., 2015). This research was conducted at a junior high school in Kulon Progo Regency, Yogyakarta. The participants involved in this study were 55 students of class VIII, consisting of 27 students in the experimental class and 28 students in the control class.

Concept mastery test is a test used to measure students' mastery of concepts. The test is in the form of multiple choice questions with four answer choices given to students before (pretest) and after learning (posttest) with the same questions in both the experimental and control classes. The concept mastery test is structured based on the cognitive process dimensions of the revised Bloom's taxonomy, which includes the ability to remember (C1), understand (C2), apply (C3), and analyze (C4). Before being used for research, the concept mastery test was first tested for its feasibility to determine validity, reliability, discriminatory power and level of difficulty.

Writing assignments are used as a way to communicate as well as a treatment for the metacognitive writing task strategy given at the end of the lesson. The rubric used to assess writing assignments (Sinaga, 2014).

Table 1. Writing Communication Ability Assessment Rubric

No.	Aspects of Journal Assessment
1.	Clarity and correctness of concepts or laws
2.	The mode of representation used
3.	The breadth and depth of the main description
4.	Conceptual hierarchy and organization of writing
5.	The main idea or big idea of writing
6.	Rules for writing and using punctuation marks

The scores from the concept mastery test were analyzed by the N-Gain test, normality test, and Mann-Whitney test. In this study, the normal gain test (Normalized Gain) was used to determine the increase in students' mastery of concepts using a metacognitive writing task strategy approach. This normalized gain score is interpreted to express the category of increasing students' mastery of concepts. The formula used in calculating the N-Gain test is as follows:

$$\langle g \rangle = \frac{\langle s_{post} \rangle - \langle s_{pre} \rangle}{100\% - \langle s_{pre} \rangle} \quad (1)$$

where $\langle g \rangle$ is Normalized gain value; $\langle s_{pre} \rangle$ is Pretest average score (%); and $\langle s_{post} \rangle$ is posttest average score (%). Data from the average N-gain value obtained are then interpreted using the gain level criteria in the following Table.

Table 2. Criteria for the Level of Average N-Gain (Hake, 1998)

N-gain Average Value	Criteria
$\langle g \rangle \geq 0,7$	High
$0,7 > \langle g \rangle \geq 0,3$	Moderate
$\langle g \rangle < 0,3$	Low

Students' communication skills are assessed using the rubric as Table 3 (Sinaga, 2014).

Table 3. Assessment Aspects of Writing Assignments

No.	Aspects of Journal Assessment
1.	Clarity and correctness of concepts or laws
2.	The mode of representation used
3.	The breadth and depth of the main description
4.	Conceptual hierarchy and organization of writing
5.	Main ideas and big ideas of writing
6.	Rules for writing and using punctuation marks

The correlation test was used to determine the relationship between concept mastery and students' communication skills. To determine the linear correlation of two variables is to use Rank Spearman correlation analysis. In determining the level of strength of the relationship between variables, we can be guided by the provisions listed in the Table 4. In addition to the correlation test, this study also conducted a simple linear regression test between students' mastery of concepts and communication skills. Correlation and regression both have a very close relationship. The regression analysis function is used to find out how the dependent variable can be predicted through the independent variables, either individually or together.

Before carrying out a simple linear regression test, a residual Kolmogorov-Smirnov normality test and a linearity test were carried out first as prerequisites for a linear regression test.

Table 4. Interpretation of the Correlation Coefficient (Sugiyono & Susanto, 2015)

Correlation Intervals	Relationship Level
0.00 – 0.1999	Very low
0.20 – 0.399	Low
0.40 – 0.599	Moderate
0.60 – 0.799	Strong
0.80 – 1.00	Very strong

RESULT AND DISCUSSION

Improved Mastery of Concepts

Students' mastery of concepts was measured using a concept mastery test instrument totaling 30 multiple choice questions for the *pre-test* and *post-test* which were tested directly in the experimental and control classes with paper-based exams and students submitted answer sheets directly to the researcher. To see an increase in students' mastery of concepts is to do the N-Gain test for the experimental class and the control class. The results of the N-Gain test in the experimental class and control class can be seen in the following Table.

Table 5. N-Gain Test for Experimental Class and Control Class

Class	Pre-Test	Post-Test Value	N-Gain Score	Category
Experiment	29.85	68	0.542	Moderate
Control	30.07	49.04	0.272	Low

Based on the Table above, it can be seen that the N-Gain score of the experimental class is greater than the N-Gain score of the control class. Students in the experimental class experienced an increase in mastery of concepts in the medium category, while students in the control class experienced an increase in mastery of concepts in the low category.

In the implementation of the metacognitive writing task strategy, each student tries to write down the difficulties they experience and the teacher can help students deal with the difficulties they face by providing feedback in the form of notes in each writing assignment assessment which can contain appreciation for the tasks that have been done, explaining again concepts that have not been understood. by students or can be in the form of suggestions for subsequent learning activities, along with words of encouragement and motivation for students. So that with the metacognition aspect in the task of writing learning activities can take place more effectively and can improve students' mastery of concepts.

The Differences in Increasing Mastery of Concepts between Experiment Class Students and Control Class Students

To find out whether there is a significant difference in increasing mastery of concepts between students in the experimental class and students in the control class, the results of the *pre-test* and *post-test* of students in the experimental class and control class were processed using the SPSS 25 application. Based on the normality test, it is known that the research data is only normally distributed in the experimental class *pre-test data*. Because not all data were normally

distributed, the researchers continued data analysis using non-parametric statistics, namely the Mann-Whitney test. The hypothesis in this study are as follows:

H_0 : There is no significant difference in increasing mastery of concepts between classes that apply a *metacognitive writing task strategy* and a class that does not apply a *metacognitive writing task strategy*.

H_1 : There is a significant difference in increasing mastery of concepts between classes that apply a *metacognitive writing task strategy* and a class that does not apply a *metacognitive writing task strategy*.

The results of data processing with the Mann-Whitney U test are as follows.

Table 6. Mann-Whitney U test

	Concept Mastery
Mann-Whitney U	79,500
Wilcoxon W	485,500
Z	-5,059
asympt. Sig. (2-tailed)	.000
a. Grouping Variables: Class	

Based on the output of "test statistics" it is known that the asymp. sig. (2-tailed) of 0.000 <0.05. So it can be concluded that H_0 is rejected and H_1 is accepted. Thus it can be said that there is a significant difference in conceptual mastery between classes that apply the metacognitive writing task strategy and classes that do not apply the metacognitive writing task strategy.

Improved Communication Skills

Students' communication skills were measured using writing assignments given to students at each meeting in learning and carried out twice. The average of the first and second writing assignments as well as the N-Gain scores for increasing writing assignments can be seen in Table 7.

Table 7. Writing Task N-Gain Test

Writing Assignment 1	Writing Assignment 2	N-Gain Score	Category
64.33	73.63	0.261	Low

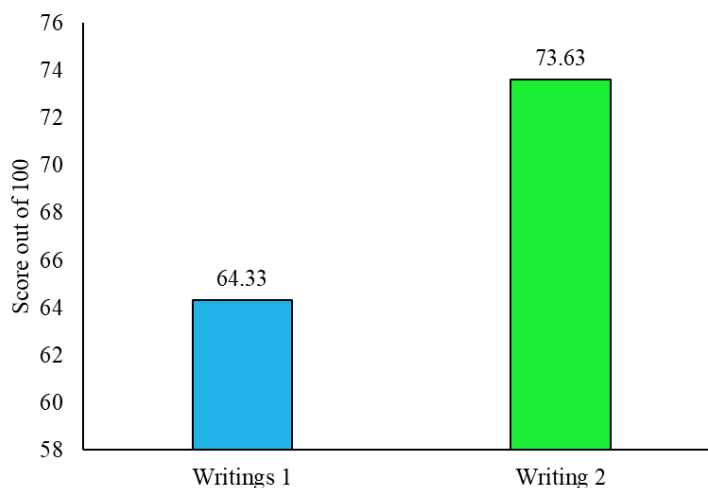


Figure 1 . Chart of Average Increase in Writing Tasks

The average student writing assignments increased from writing assignments one to writing assignments two, from 64.33 to 73.63. However, from the N-Gain Score test, an N-Gain score of 0.261 was obtained in the low category, which means that students' communication skills have increased even though they are in the low category.

Improving communication skills through writing can be seen from various factors, namely as stated in the writing assignment assessment rubric. Among them are the completeness and depth of the material written, the representations used, and the students' writing rules. If you look at the representations used, most students are proficient at using various representations to explain a concept and there are also students who are not used to using various representations in writing. writing so that the writing becomes less "alive" and representative.

Physics learning using a metacognitive writing task strategy is learning by applying various writing activities such as writing summaries and reflections with metacognitive aspects. One form of communication is through writing, communication skills in written form can be seen from writing activities, with writing assignments at school it is hoped that it can help students to improve student communication skills. Writing assignments are used as a way to communicate as well as a treatment for the metacognitive writing task strategy given at the end of the lesson.

Correlation between Concept Mastery and Communication Skills

Because the data obtained were not normally distributed, the researchers conducted a correlation test with non-parametric statistics, namely by using the Rank-Spearman Correlation Test.

Table 8. Rank-Spearman Correlation Test Results

		Concept Mastery	Communication Skills
Spearman's rho	Concept Mastery	Correlation Coefficient	1,000
		Sig. (2-tailed)	.758 **
		N	27
Communication Skills	Concept Mastery	Correlation Coefficient	.758 **
		Sig. (2-tailed)	1,000
		N	27

** . Correlation is significant at the 0.01 level (2-tailed).

From the Table above it can be seen that there is a significant relationship between concept mastery and communication skills. From the Table it is obtained that the correlation coefficient is 0.758, which means that the level of strength of the relationship between the variables of mastery of concepts and communication skills is 0.758 which is included in the category of strong correlation. Because the correlation coefficient is positive, the relationship between the two variables is unidirectional, which means that as students' mastery of concepts increases, students' communication skills will also increase.

Simple linear regression analysis is used to test the effect of one independent variable on the dependent variable. Some of the requirements to be able to perform a simple linear regression test are the residual values of the data used which are normally distributed and linear data.

Table 9. Table of Simple Linear Regression Test Results (Part 1)

Model	R	R Square	Adjusted R Square	std. Error of the Estimate
1	.832 ^a	.692	.674	7,397

a. Predictors: (Constant), Concept Mastery
 b. Dependent Variable: Communication Skills

The Table above explains the value of the correlation or relationship (R) of 0.832. From the output, the coefficient of determination (R square) is 0.692, which means that the effect of the independent variable (concept mastery) on the dependent variable (communication skills) is 69.2%.

Table 10. Table of Simple Linear Regression Test Results (Part 2)

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	std. Error	Betas		
1 (Constant)	17,924	9,232		1942	.069
Concept Mastery	.876	.142	.832	6,180	.000

a. Dependent Variable: Communication Skills

From the Coefficients Table, a significance value of 0.000 < 0.05 is obtained, so it can be concluded that the concept mastery variable (X) has an effect on students' communication skills (Y). It is known that the constant value (a) is 17.924, while the concept mastery value (b) or regression coefficient) is 0.876, so the regression equation can be written:

$$Y = a + bX \tag{2}$$

$$Y = 17,924 + 0,876X \tag{3}$$

A constant of 17.924 means that the consistent value of the communication skills variable is 17.924. The regression coefficient X of 0.876 states that for every 1% addition of concept mastery, the value of communication skills increases by 0.876. The regression coefficient is positive, so it can be said that the direction of the influence of variable X on variable Y is positive. From the explanation above, it can be concluded that the relationship between mastery of concepts and communication skills is proven to be unidirectional, which means that as students' mastery of concepts increases, students' communication skills will also increase, so it can be seen that increased student mastery of concepts coincides with increased student communication skills, so that with the implementation of the metacognitive writing task strategy in learning will prove to be able to improve students' mastery of concepts and communication skills simultaneously.

CONCLUSION

Based on the research that has been done, it can be stated that the implementation of the metacognitive writing task strategy in learning can improve students' mastery of concepts and communication skills. The relationship between concept mastery and communication skills is proven to be unidirectional, which means that as students' mastery of concepts increases, students' communication skills will also increase. Based on the research that has been carried out, suggestions that can be conveyed to future researchers are that research should be carried out in a fairly long period of time so that a significant effect can be seen from implementing the

metacognitive writing task strategy in improving communication skills and mastery of concepts. Then future researchers can also use other learning models besides discovery learning so that learning with this strategy becomes more effective.

REFERENCES

- Hake, R. R. (1999). Analyzing change/gain scores. AREA-D American education research association's deviation. D. *Measurement and Research Methodology*.
- Johnson, D. W., & Johnson, R. T. (1998). Cooperative learning and social interdependence theory. In *Theory and research on small groups* (pp. 9-35). Boston, MA: Springer US.
- Kaewkhong, K., Mazzolini, A., Emarat, N., & Arayathanitkul, K. (2010). Thai high-school students' misconceptions about and models of light refraction through a planar surface. *Physics Education*, 45(1), 97. <https://doi.org/10.1088/0031-9120/45/1/012>
- Kamaruzzaman, K. (2016). Analisis keterampilan komunikasi interpersonal siswa. *Journal Konseling Gusjigang*, 2(2). 202-210. doi: <https://doi.org/1023176/jkg.v2i2744>.
- Kemendiknas. (2020). *Pengembangan Pendidikan Budaya dan Karakter Bangsa*. Jakarta: Kementerian Pendidikan Nasional.
- Maryanti, S. (2012). Hubungan antara keterampilan komunikasi dengan Aktivitas Belajar Siswa. *Konselor*, 1(2), 1-8. <https://doi.org/10.24036/0201212700-0-00>
- Musliah, Purwanti, & Yuline. (2015). Analisis keterampilan komunikasi siswa dengan teman sebaya di sekolah menengah atas. *Jurnal Pendidikan dan Pembelajaran*, 4(12). 1-13.
- Ouattara, F., & Boudaoné, B. (2012). Teaching and learning in geometrical optics in Burkina Faso third form classes: Presentation and analysis of class observations data and students' performance. *British Journal of Science*, 5(1). 83-100.
- Shefityawan, W. B., Prihandono, T., & Lesmono, A. D. (2018). Identifikasi miskonsepsi siswa menggunakan four-tier diagnostic test pada materi optik geometri. *Jurnal Pembelajaran Fisika*, 7(2), 147-153.
- Sinaga, P. (2014). *Pengembangan program perkuliahan fisika sekolah untuk meningkatkan kompetensi menulis materi ajar calon guru menggunakan multi modus representasi*. Universitas Pendidikan Indonesia: Sekolah Pasca Sarjana.
- Slavin, R. E. (2018). *Educational psychology, theory and practice, 12th Edition*. New York: Pearson.
- Sugiyono. (2015). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta.
- Sugiyono & Susanto. (2015). *Cara mudah belajar SPSS dan lisrel teori dan aplikasi untuk analisis data penelitian*. Bandung: Alfabeta.
- Sumantri, M. S. (2015). *Strategi Pembelajaran: Teori dan Praktik di Tingkat Pendidikan Dasar*. Jakarta: Rajawali Press.
- Sutopo. (2014). Miskonsepsi pada optika geometri dan remediasinya. *Journal Teaching Quality Improvement Programs*, 5(2), 356-368
- Wati, M. Y., Maulidia, I. A., Irnawat, I., & Supeno, S. (2019). Keterampilan komunikasi siswa kelas vii smpn 2 jember dalam Pembelajaran Ipa dengan model problem based learning pada materi kalor dan perubahannya. *Jurnal Pembelajaran Fisika*, 8(4), 275-280. doi: <https://doi.org/10.19184/jpf.v8i4.15237>
- Yusefni, W. & Sriyanti, S. (2016). Pembelajaran IPA terpadu menggunakan pendekatan science writing heuristic untuk meningkatkan kemampuan komunikasi tulisan siswa SMP. *EDUSAINS*, 8(1), 9-17. <http://dx.doi.org/10.15408/es.v8i1.1562>