



## Opinions of High School Students About the Writing Technique Applied in the Mathematics\*

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Received: 18.05.2018; Accepted: 28.11.2018; Published: 15.12.2018

**Abstract:** The writing technique emerges as one of the techniques used to develop metacognitive knowledge and behaviour with the ability to think aloud on paper. The purpose of this study is to reveal the views of high school students about the writing exercises used in mathematics lessons and to examine their perspective to develop metacognitive behaviours. Qualitative research methods were used in the research. The participants of the work constitute a total of 64 students who attended 9th and 10th grade in a high school located in a province of Yozgat in the second semester of the 2015-2016 academic year. Different writing activities were applied to mathematics courses for 6 weeks. These activities are based on writing activities that develop metacognitive behaviours unlike traditional writing in mathematics lessons. In addition, the students kept the math log throughout the process. At the end of 6 weeks, the students were asked to evaluate the process. The findings show that students are generally satisfied with the writing technique applied, that these activities improve students' affective, cognitive and metacognitive aspects, but that some students are reluctant to write in the journal.

**Keywords:** metacognition, writing, high school students.

### INTRODUCTION

One of the aims of our curriculum is to develop behaviour, such as the ability to know what students know and can do. It also aims to improve behaviours such as determining the way students will follow in case they are encountered, checking themselves and asking themselves questions while they are working on a subject, evaluating themselves and leaving at the end of the process, and to raise awareness in these issues. These behaviours are defined by the concept of metacognition. Metacognition, in the shortest sense, means that one is aware of his own processes of thinking and

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\* This study was presented as an oral presentation at the International Conference on Mathematics and Education (ICMME-2018) on June 27-29.

**Citation:** Kartalci, S., & Demircioğlu, H. (2018). Opinions of High School Students About the Writing Technique Applied in the Mathematics. *MATDER Journal of Mathematics Education*, 3(2), 8-17.

can control these processes (Brown, 1978, Flavell, 1979, Wellman, 1985, Beauford, 1996, Huitt, 1997, Hacker and Dunlosky, 2003, Jager, Reezigt, 2005, Transporter: Özsoy, 2007). MEB Mathematics Curriculum (2018) emphasizes that in the Learning Objective section of the Mathematics course, "She/he will develop metacognitive knowledge and skills, will manage her/his own learning processes consciously". Indeed, as metacognitive knowledge and skills develop, it is inevitable that learners become more conscious of learning and one step closer to teaching learning.

Various methods can be used to improve metacognition. One of them is writing that is one of the ways of communicating which is among the skills of the 21st century. Writing is also expressed on the paper as voice thinking. When students write, they think more closely about what they know, what they can do, what they are doing, and synthesize all of them to form meaningful sentences. This contributes to the development of both cognitive and metacognitive skills.

When students are given the opportunity to reflect their work through writing, metacognitive behaviours are allowed to make sense of the correct understanding (Rice, 2004).

Different types of writing can be used depending on the purpose of education and the subject. It is used for expressive writing, transactional writing, poetic writing, journal writing, expository writing, impromptu writing prompt, writing prompts are the most common types of writing in the summer (Emig, 1977, Ishii, 2003, Lynch, 2003, Miller, 1992, Shield and Galbraith, 1998, Uğurel and Morali, 2009). Expressive writing is a kind of writing in which feelings and thoughts are conveyed intimately. Transactional writing is intended to reveal something, to reveal something, and to write personal information in a serious atmosphere without being exposed. Poetic writing is a writing made by embellishing the subject on a subject and adding literary and aesthetic qualities. Journal writing is a type of writing that allows students to observe what they have done during the course and reflect their feelings and thoughts at the end of the day. Expository writing aims to inform about a subject and describe a concept. An impromptu writing prompt is a writing that starts with the teacher's instructions on a subject and gives the students freedom. In writing prompt, the frame to write is more limited. There is no definite distinction between these types of writing, and they can sometimes go into each other's fields. In addition, some writing activities can provide some of the features of these writing types more than once.

In mathematics education, the use of writing is becoming more widespread. Because writing which used in mathematics is a technique that increases the success of problem solving learning. Because writing in mathematics requires that students organize, classify and reflect their thoughts, and all of these are useful processes for making sense of mathematics, writing in mathematics supports learning (Burns, 2004). Metacognitive behaviours emerge when students write about problem solving processes (Pugalee, 2001). Thus, both metacognitive behaviours develop and mathematical understanding and learning levels are increasing. In this study, it was aimed to examine the opinions of the students about the writing technique used in high school mathematics course to develop metacognitive behaviours.

## METHOD

The researcher-teacher model, which is one of the qualitative research methods, was used in this study which aims to reveal the views of high school students about the writing studies used in mathematics lesson and to examine the points of view in order to develop metacognitive behaviours. This model aims at identifying and solving a specific problem in the field of education (Cohen, Manion and Morrison, 2007).

## Study Group

The working group constitutes a total of 64 students in 9th and 10th grade in a high school located in a province of Yozgat in the second semester of 2015-2016 education year. One branch (20 people) in the 9th grade and two branches (21 and 23 people in the 10th grade) participated. The reason why the study is applied to these branches is that the researcher-teacher is the mathematics teacher of these classes. In short, convenience sampling method was used. On the other hand, classes 9 and 10 are important because they are the first two stages of the transition to the high school.

## Writing Activities

Firstly, writing activities were prepared by using the writing applications used in mathematics to develop metacognitive behaviours (Özsoy, 2007; Pilten, 2008; Demircioğlu, 2008). These activities, which were prepared taking the curriculum into consideration, were also finalized by taking expert opinions. Expository writing, impromptu writing prompt, writing prompt, expressive writing and journal writing were used. During the first weeks, activities were organized with more encouragement and direction, while in the following weeks the activities were reduced, leading to more freelance writing. The reason for this is to direct metacognitive behaviours such as how and why they are doing rather than focusing on cognitive behaviours, such as "I multiplied, I divided,...", when they write down what they think about the problem-solving process.

In the three branches where the researcher entered the lessons as a teacher, the writing activities related to the topic were applied for 6 weeks. These activities were usually carried out in the last math lessons of the week. The student activity papers were collected and reviewed weekly by the investigative teacher and written back on the papers and distributed back to the students the following week. These feedbacks are small notes that are written on the edges of the papers, "You should explain it in more detail, You went right, You wrote that you have identified the escape between the triangles, but you have not actually identified them, You must write how you understand the truth, This time your estimates are more consistent,...". These notes will enable learners to be informed about their own situation and to guide them to metacognitive behaviours. In addition, each activity paper was scanned by the teacher and transferred to the computer environment. At this point both the researcher was able to follow the process and she could observe the changes in the participants.

A transparent file was affixed inside the back of the students' notebooks and students were asked to review the feedback given to the activity sheets by their teachers and to save the activity sheets in this file. Students are also asked to keep a math journal. After each mathematics lesson, when students go home, they are asked to write about these topics, such as what they worked on that day, what they understood and did not understand, what they attracted most, and where they got squeezed. In this way, students have to make a retrospective evaluation after a certain period of time.

## Collection of the Data and Analysis of Data

At the end of six weeks students were asked to observe the events collected in their files and to evaluate the process in accordance with the instruction given in Figure 1.

**Figure 1: Instruction for students to make assessments at the end of the process**

*Dear students, as you know, we have done activities related to the topics we have been working on every week for 6 weeks, one event per week. Also, if you go home after every math lesson you are asked to write "math lesson diary". In order to evaluate these studies, you are asked to write your opinions so that they contain the answers to the following questions. Please describe your feelings and thoughts in detail.*

- 1) Do you think that you have given the necessary attention and attention to the work done and are actively participating?*
- 2) How do you find your own performance and progress in the process?*
- 3) What might be the purpose of these studies?*
- 4) Did these studies bring you something, what did it gain you?*
- 5) Would you like to continue such studies?*
- 6) What kind of changes do you want to make in these studies?*

The purpose of these questions is to guide the students about the topics which they will focus on, when they are evaluating. In other words, these questions are not intended to be answered in the form of questions and answers, but to make sure that the students are within a certain frame of content in terms of content. As a matter of fact, considering students' writing, it is seen that instead of responding individually to the questions, the students generally evaluate the process, they write about the contribution of the study in general and the feelings and thoughts about the study.

This assessment took about one hour (40 minutes) as it was done in mathematics lesson. Then, these assessments written by the students were collected. The data were analyzed by content analysis. First, each student was given a number. Then the collected papers were transferred into the computer environment by leaving branches. Each article has been examined separately. Later, similar expressions were gathered together and positive and negative opinion categories were formed. In addition, categorizations have been exemplified by making quotations from evaluations of students. Creswell (2013) mentioned the importance of long-term participation and detailed descriptions for validity in qualitative studies. This was an increasing factor in the validity of the study as there was a long association with the study group in this study. In addition, descriptions were made by making quotations from student papers. For the reliability of the study, the categorizations were made while the expert opinions were utilized and the process was reflected in a transparent manner with careful examination.

**FINDINGS**

In this study, in the high school mathematics lesson, the evaluations of the learner about the writing technique used to develop metacognitive behaviours are examined. At the end of the process, the students evaluated the process as a whole when accompanied by the guidance questions given in the guide. According to these evaluations, opinions are mainly divided into two parts, positive opinions and negative ones, and subcategories are formed for these opinions and the frequencies belonging to these categories are given in Table 1. On the whole, it has been seen that students evaluate the applications made and the reflections of these applications on themselves. Because some students have expressed a few different opinions, they are also written under different categories. In addition, while Table 1 was generated, opinions were given separately for the classes. The reason for this is to determine whether variables such as grade and branch are influencing these views.

**Table 1: Categories from student views**

Opinions		9-A	10-A	10-B	Total	%	
Positive	Affective	I would like these activities to continue.	14	14	11	39	60.9
	Metacognitive	Activities and journals were effective on the repetition and reinforcement of the subject.	7	5	8	20	31.2
		It helped me to recognize myself.	8	0	1	9	14
	Metacognitive	It helped to self-assessment.	1	3	0	4	6.2
		I became aware of my mistakes.	1	2	2	5	7.8
	Metacognitive – Cognitive	I made progress in solving problems by explaining and expressing myself.	6	4	2	12	18.7
	Cognitive	My approach to questioning and problem-solving performance improved.	3	0	7	10	15.6
	Metacognitive	When solving a question, I learned to go with certain steps and ask myself some questions. (problem solving steps and metacognitive steps)	4	0	8	12	18.7
		It provided a better understanding of the lesson or the subject.	3	3	7	13	20.3
	Metacognitive – Cognitive	I improved in mathematics, my performance improved, my grades rose.	6	2	9	17	26.6
	Metacognitive	I have developed in thinking and reasoning.	0	2	4	6	9.4
	Affective	My interest, my love, my desire in mathematics and solving questions increased, and my self-confidence developed.	6	2	6	14	21.9
	Affective	The math lesson was more enjoyable.	1	2	1	4	6.2
		Other positive developments.	3	4	5	12	18.7
Negative	I find the activities tiring or boring, I do not like to write explanations, when I cannot do it, I feel blue.	4	2	1	7	10.9	
	I don't want to write a journal.	4	2	2	8	12.5	

As seen in Table 1, students often expressed a positive opinion of the applications they had made. The majority of the students (60.9%) stated that they wanted these activities to continue. It can be interpreted that these students liked and enjoyed the activities carried out throughout the process, that the activities contributed to the emotional contribution. Indeed, researcher-teacher observations support this. Students have actively participated in the activities carried out throughout the process. They have done all the activities in the classroom and in the house completely.

Examples from student views in category "I would like these activities to continue.":

*"We must continue to do activities. I don't want any changes to work, I want it to continue in the same way"*

*"I hope that this work will continue in this way well."*

In addition, 31.2% of the students who participated in the study indicated that the applications were contributing to the repeat of the courses and to the consolidation of the subjects. This is a cognitive contribution. This is interpreted as the fact that the students think that they are going through the process, to repeat the topics, and therefore contribute to the problem-solving skills of the subject.

Examples from student views in category "Activities and journals were effective on the repetition and reinforcement of the subject.":

*"I think our activities are very useful. Because we repeat the issues. For example, we write about what we do in our classes every day, even this is being repetition."*

*"The journal helped us repeat."*

They stated that when students go home and write about the topics that are being done that day, they have to re-examine them. This is not the only goal of the printed journals, but the contribution of the journals has been emphasized by many students. When solving the questions in the activities, it can also affect the permanence of the information by means of writing through which the students think more and occupy their minds in a long and intensive way.

Frequency was higher in other categories, *"I improved in mathematics, my performance improved, my grades rose."* (% 26.6), *"My interest, my love, my desire in mathematics and solving questions increased, and my self-confidence developed."* (% 21.9) and *"It provided a better understanding of the lesson or the subject."* (% 20.3). Note that these categories actually support each other. Providing a good understanding of the lesson and the subject is the metacognitive contribution of the activities. When the course is better understood, this will improve performance and cognitive development will have a visible function. The increase in performance and the improvement in grades will increase the self-confidence of the student and contribute to the motivation, the affective development by increasing the interest in the lesson.

Examples from student views in category "I improved in mathematics, my performance improved, my grades rose.":

*"Because I gave the necessary care in the studies, it make the exam easier for me. I had forgotten how to do the problem in the middle of the exam. At the moment, the activities came to my mind and because I wrote the subject to my journal the day of the day, I remembered the subject directly. It gave me 20 points in the exam."*

*"Thanks to these studies I passed the math exam. I felt on top of the world."*

Some of the students stated that the activities and the journals held were positive effects on the written examination notes and that they increased the success in mathematics. These effects may be due to the contributions of the practices made to the permanence and consolidation of the lessons. It may also be due to the fact that writing efficacy increases awareness of learning.

Examples from student views in category "My interest, my love, my desire in mathematics and solving questions increased, and my self-confidence developed.":

*"I didn't understand much from mathematics. But some of these activities made me love mathematics a little bit, and helped me to solve the examples."*

*"I would like to say sincerely; I think I developed myself about mathematics. In the past, I couldn't solve any questions, but I could solve the equation! Can you believe it? I did mathematics activity. Something strange is to solve mathematics. I'm very happy and proud, I have confidence in myself when I solve math."*

It is understood that the writing activities made from the expressions of the students contributed positively to the motivations, comments, love, in short, the affective areas of the lesson as it contributed to the students going one step forward in mathematics.

Examples from student views in category "It provided a better understanding of the lesson or the subject.":

*"In our activities, I saw that mathematics is not difficult, it can be done when understood These activities proved to me that mathematics is not difficult. The activities were useful to us to understand the issues. It's nice to write a letter."*

*"These studies help us better understand our subjects."*

They stated that they were beginning to understand the issues better and that they were beginning to think that mathematics was an understandable, constructable lesson. It seems to be

supported by the fact that writing in these responses of students has developed metacognitive thinking and thus opens the door to more meaningful learning.

Examples from student views in category "It helped me to recognize myself.":

*"I know that these studies are to recognize ourselves."*

*"In these studies I learned to recognize myself. Maybe I didn't know myself before in math class."*

Some students thought that the purpose of these events was to "get to know themselves". The reason for such thinking is that the activities are designed to develop metacognitive behaviours, and the end result may be to make them aware of their knowledge of the job they are doing. This "awareness" may have contributed to their learning by learning new things about themselves and thus to their self-identification.

Examples from student views in category "It helped to self-assessment.":

*"I believe that these works will be of great benefit to us. In these six weeks, we had to evaluate ourselves. Are we enough for our questions, and what we can't do?"*

*"We have evaluated ourselves."*

It seems that the parts of the activity to improve the evaluation component of metacognition are useful. Students expressed the view that the activities have contributed to their thinking about what they can and what cannot do.

Examples from student views in category "I became aware of my mistakes.":

*"I noticed my mistakes in the activities we did in the process. Wherever I have done wrong, I tried to solve the question again and try to be careful in other activities."*

*"Most importantly, I think it's helpful to see our mistakes. Our mistakes ... It is nice, isn't it? I think it's the most important thing to know where a person is wrong, to know where the problem is, to correct our problem."*

Some of the students stated that they have been trying to correct them by noticing the mistakes in the activities and the feedbacks of the activities and they have questioned themselves in this matter. The reason for students to be aware of their mistakes when doing activities is that they can think more intensely while writing and can watch themselves and their work together with it. At the end of the activities or by looking at the feedback, they may be accustomed to evaluate themselves and what they do in the process of expressing their mistakes.

Examples from student views in category "I made progress in solving problems by explaining and expressing myself.":

*"In order for a person to express himself / herself, he / she should focus on some things and do some activities. The activities that our teacher has made us like this have enabled us to express ourselves."*

*"I noticed in the activities that I was writing very short things in the first week, short answers like yes-no. Then I realized that I was starting to write more clearly and correctly."*

The focusing which student mentioned has been tried to be achieved through writing in this work. Thus, through writing, students' concentration on the subject may have started to better express themselves by arranging and organizing their ideas better. Similarly, this student also stated that he has developed in time to express himself by writing, explaining and solving the questions.

Examples from student views in category "My approach to questioning and problem-solving performance improved.":

*"At first I couldn't solve it very well. But later, I saw that I could solve the questions. I think I developed myself."*

*"Has there been any improvement? Of course. For example, I can read more carefully and understand better. These studies helped me to better understand the question, to solve the question, to love."*

It is understood that thanks to the applications made, the students gain the habit of reading more carefully, understand the importance of understanding, interpreting and analyzing the question. It is also evident that on this issue they have indicated that they have developed appropriate solutions to find the solution and reach a solution in a correct way.

Examples from student views in category "When solving a question, I learned to go with certain steps and ask myself some questions.":

*"The best way to solve the question is to go step by step. I've learned to write step by step not directly in this work."*

*"To think that I can solve the question before we solve the question, to read the question a few times to understand it, to solve ourselves after solving the question has really developed me very much. At least I can think of what I can do if I can't. So my performance has improved considerably."*

Since students are usually used to solve the questions immediately before study, they found strange to think slowly by considering certain steps, thinking that they can compare the subject with their own knowledge, asking them questions to inquire, writing every thought, constantly checking and evaluating at the beginning of the study. However, as we have seen, some students have expressed that they are used to this situation over time and see the benefits of solving it in this way.

Examples from student views in category "I have developed in thinking and reasoning.":

*"These studies have given me a lot of things like logic execution."*

*"Our reasoning is improved and our ability to solve questions more quickly is developing."*

In the previous categories, some of the students expressed that they do not know how to start or ask questions in advance, but the activities that have been carried out have made progress in this respect. Similarly, the expressions in the category "Developing in thinking and reasoning" can mean that students learn how to think with a math problem and learn how to act with logic, thanks to applied activities slowly. While students are used to quickly matching out information and formulas from memorized machine-like before, the reasoning processes may be improved when they are asked to progress step by step according to certain strategies.

Example from student views in category "The math lesson was more enjoyable.":

*"This year, the math lesson goes well, it's fun, it's not boring, it's fun. It's fun for me. This year we did very good activities, we also kept a math journal."*

Since the activities that have been held have changed the course of mathematics from the traditional atmosphere, there has been a change for the students, which is found more colorful, interesting and enjoyable by some students.

Example from student views in category "Other positive developments.":

*"If other teachers do it this way, we can come to better points. The teachers gather papers and see who does not understand what. He repeats the matter and does the same activity again. In this way, everyone can express clearly that they do not understand."*

This student mentioned the possible contributions of strengthening the communication between the student and the teacher. According to him, if a student write that he doesn't understand on the activity papers, or if the teacher knows that the student doesn't understand from student's paper, the teacher can work to resolve this problem. In this way, the subject is understood by the whole class. In the expressions of this student, there is an indication that students write and

express feelings and thoughts and difficulties in a more comfortable way without hesitation. Writing really contributes to the mathematical communication in the math class.

Example from student views in category "Other positive developments.":

*"Our activities and our journals gave us a lot of things. In the journals, we wrote our feelings and thoughts that we could not say in the lesson. In short, what we did in math class that day, what we have experienced in that lesson we wrote them."*

This student also emphasizes that writing provides a more comfortable environment to explain feelings and thoughts. In the normal course of study, some students may hesitate to express their feelings and thoughts, and to express the points they do not understand. Indeed, writing provides an alternative environment for expressing such situations. Since the number of negative opinions is very small, there are not many subcategories. As negative opinion (12.5%) they do not want to write a journal by stating that they get lazy to a journal writing. The reason for this may be that the students have not encountered such an application before and that they are not accustomed to this situation. In addition, the journal writing application may be perceived as a homework by some students and may be reluctant to students as it is in all compulsory operations.

Example from student views in category "Negative opinions.":

*"I paid attention to all, but sometimes I was a little bored. Because I like to solve the questions, but it's bothering me to explain them again."*

Since this student is not accustomed to solving the problems by explaining the questions and he has worked result-oriented rather than process until now, he found boring to write his thoughts with long explanation. The student may be considering this as an unnecessary process. As a matter of fact, the expression "to explain again" suggests the idea that the student does not write what he thinks simultaneously while solving the questions, but writes an explanation after solving it. If he is doing this, he might be find unnecessary this study and warnings.

Example from student views in category "Negative opinions.":

*"It's hard for me to leave the TV in the evenings and write a diary. So I write a bit and then I quit."*

This student stated that a journal writing was an extra work done at home in the evening and that he got lazy and the television audience was more enthusiastic.

## DISCUSSION

From the findings, it is seen that the students are generally satisfied with the applied writing technique. It has been stated by some students that writing activities provided improving metacognition enable them to solve problems better. Indeed, it is known that the development of metacognitive behaviours increases the problem solving success (Özsoy, 2007). A key way for pupils to improve their problem-solving skills and encourage mathematical righteousness is to improve their metacognitive awareness (Rice, 2004). It is understood that in this study, the development of metacognitive behaviours as well as the development of problem solving and mathematics understanding areas.

Some students have expressed that the writing activities will contribute to mathematical communication in the classroom by allowing them to share their feelings and thoughts more easily. Some students have stated that the writing activities increased their interest and love to math and developed their own confidence. Atasoy, Baki and Atasoy (2005) also reached that the use of writing in the course process contributed to the mathematical communication of the class, the motivation of the students, their self-confidence and interest in the course.

Students also stated that they are developing in metacognitive skills such as self-awareness, monitoring and evaluation skills. This result is parallel to the study of Çolak, Bulut and Argün (2005).

In summary, the students stated that these activities have cognitive gains such as learning the lesson, understanding the subject, approaching the questions, as well as affective gains such as increasing the interest and love of the lesson and developing self-confidence. Similar results were obtained with the study conducted by Sağırılı (2010) with university students.

Although the negative opinion is little, most of them seem to complain about journals. When the really written journals were examined, it was seen that most of the students were getting tired and shortened the journals. This result is inconsistent with the findings of Jurdak and Zein (1998) that journal writing is useful both cognitively and emotionally. In this context, journal writing is not recommended for high school students in future studies. Instead, techniques involving technological devices that can attract more attention to students can be used.

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