Educational Policy Analysis and Strategic Research, V18, N3, 2023

Preservice Preschool Teachers' Opinions About Writing to Learn Mathematics and The Methods They Use While Writing

Ferhat ÖZTÜRK[1]
Kırıkkale University

Abstract

This study aims to determine pre-service preschool teachers' opinions about writing to learn mathematics and the methods they use while writing. Survey design, one of the quantitative research methods, was used in the study. The sample of the study consisted of a total of 418 pre-service teachers studying in the preschool teaching undergraduate program of six different state universities. The Likert-type questionnaire developed by Ozturk and Gunel (2015) was used to collect data. Frequency analysis, Mann-Whitney U test and one-way analysis of variance (ANOVA) were used in data analysis. According to the results obtained from the study, it was determined that pre-service preschool teachers used revising writing and planned writing processes when the methods they used while writing about learning mathematics were taken into consideration. When this situation is evaluated, it can be said that the pre-service teachers carried out a comprehensive writing process. On the other hand, no significant difference was found between pre-service teachers' thoughts about writing to learn mathematics and their gender and grade level. In addition, although there was no significant difference between pre-service teachers' opinions about the methods they used while writing to learn mathematics and their grade levels, a significant difference was found according to the gender variable.

Keywords: Mathematics Learning, Writing to Learn, Pre-Service Preschool Teacher

DOI: 10.29329/epasr.2023.600.21

Submitted: 01 April 2023 **Accepted:** 07 July 2023 **Published:** 30 September 2023

[1]Assist. Prof. Dr., Faculty of Education, Kırıkkale University, Kırıkkale, Türkiye, ORCID: 0000-0003-2849-8325

Correspondence: e-mail: ferhatozturk@kku.edu.tr

Introduction

In today's understanding of education, the primary goal is to raise individuals who can continuously follow innovations in science and technology and who can produce solutions to social problems, whether economic, social or environmental. Individuals within the scope of this goal become ready for life with the specified competencies to the extent that they have creative, analytical and critical thinking skills and can make informed decisions by questioning. Countries and societies, aware of how important it is to raise individuals with the aforementioned characteristics, take different steps to bring the manpower needed in today's world to life. In this sense, societies approach education and training activities much more sensitively and resort to some innovations in their understanding of education. As a result of these steps taken to raise qualified individuals, it is known that the traditional understanding of education and training and the methods and techniques applied in this context are insufficient to serve the purpose. In this direction, it is seen that the use of many methods and techniques as an alternative to traditional teaching methods has become widespread and different methods and techniques have started to show their existence day by day. One of these methods is writing activities for learning purposes, which attracts attention with its possibility of use in different disciplines. As the name suggests, it is thought that it is important to examine the concept of writing before addressing the scope of writing to learn activities that emphasize the contribution of writing to learn.

Writing is defined as the expression of feelings, ideas, thoughts, plans, events and things seen and experienced in writing within the framework of certain rules and with certain signs (Demir, 2013). Yıldırım et al. (2009) consider writing an important learning product that reflects the individual's qualities along with the knowledge and skills learned. Moreover, it is possible to make ideas and thoughts more understandable and organize and synthesize them through the act of writing. The scope of writing, which includes processes such as imagination, decision-making, questioning and organizing information (Demirbağ, 2011), can be expressed as a new perspective and a problem-solving process (Flower & Hayes, 1981). Writing, which acts as a bridge between previously learned information and newly learned information and enables the integration of both information (Ozturk & Gunel, 2015), is also considered a learning process that enables the individual to think about what the learned information means for the individual (Graham, 2008; Öztürk et al., 2022). The effects of writing on learning, its role in the learning environment and its adaptation to field education have led to the opening of new areas of investigation. As a result of the research on the aforementioned topics, it is accepted that there is a strong relationship between writing and learning, considering the fact that writing is an important learning tool that contributes to learning (Eryaman, 2008; Graham, 2008; Hand & Prain, 2002; Kayalap, 2021; Klein & Rose, 2010; Öztürk et al., 2016a; Rivard & Straw, 2000; Sedita, 2015; Tynjala, 1998; Watts et al., 2022). In this sense, the fact that writing is both a pedagogical and epistemological learning tool in the learning process (Ozturk & Gunel, 2015) has

enabled it to be considered as a part of educational practices in the form of WTL (Günel, 2009; Hand et al., 2007; Tynjala, 1998). From this perspective, writing activities in the learning process, in other words, WTL, are fed by the power of writing. WTL, which supports different learning methods and strategies and increases learning outcomes (Drowns-Bangert et al., 2004; Van Dijk et al., 2022), helps students express and compare their ideas and facilitates their understanding of the new subject through conceptual change. WTL (Mason & Boscolo, 2000), which is considered a process in which students are able to interpret and reflect on information, ensures that their thoughts are more organized and well-grounded (Jaafar, 2016; Öztürk et al., 2022; Rivard & Straw, 2000). Klein (2000) points out that with WTL, the information is available for the individual for a long time and in fact, thanks to WTL, what is learned is learned without misconceptions and individuals are supported to examine the information deeply and the information is ensured to be permanent (Hand et al., 2007; Hand & Prain, 2002; Hohenshell et al., 2004).

When the national and international studies on WTL are examined, it is seen that the studies are generally focused on science education and the relationship between WTL and learning outcomes is examined (Çömen & Uzun, 2022; Galbraith et al., 2005; Gunel et al., 2007; Gunel et al., 2009; Hand & Prain, 2002; Hand et al., 2007; Oz & Kabatas-Memis, 2018; Öztürk et al., 2022; Prain & Hand, 2006; Sinaga & Feranie, 2017; Wright et al., 2019). Again, when the details of these studies on WTL are examined, it is revealed that WTL increases students' academic achievement and positively affects their higher-order thinking and scientific process skills, attitudes and perceptions towards science, and content knowledge. The fact that the benefits it provides to the educational process have been proven in both national and international literature supports that WTL should become a part of educational practices. On the other hand, in order for teachers and pre-service teachers to make WTL a part of their classroom practices, it is necessary to first determine their knowledge, skills and attitudes about WTL and then provide them with the necessary professional formation. In addition, it is considered important to determine the opinions of teachers and pre-service teachers about writing and the methods they use in writing processes. As a matter of fact, in countries that are aware of this importance, it is seen that there is a tendency towards research in which the perceptions of teachers and pre-service teachers in different branches towards writing and the methods they use while writing are tried to be determined (Demirbağ et al., 2015; Doğan & İlhan, 2016; Glen, 2008; Hand & Prain, 2002; Kabataş-Memiş, 2014; Ozturk & Gunel, 2015; Öztürk et al., 2016a; Öztürk et al., 2016b; Wallace et al., 2004). For example, Ozturk and Gunel (2015) determined the perceptions of science teachers on this issue with the inventory they developed as a result of the inventory development study they conducted to determine science teachers' perceptions of writing and writing to learn purposes. As a result of the study, the researchers found that teachers used writing as a learning tool in their own writing processes and believed that writing served the same purpose for their students, while the level of teachers' use of WTL was limited. Again, Glen (2008) found that teachers think writing is a

structure supporting the teaching-learning process. Focusing on the studies in which teachers and pre-service teachers' perceptions towards writing and the methods they use while writing are tried to be determined, it is noteworthy that these studies were conducted with science, mathematics, classroom and social studies teachers and pre-service teachers. From this perspective, it is striking that there is no study conducted with preschool teachers and pre-service teachers in this field. On the other hand, considering the positive effects of WTL on learning outcomes and the research mostly conducted in the field of science education, the fact that writing has an important place for mathematics learning, especially in terms of abstract concepts such as science and subjects that are difficult to understand for students, emerges. This study was designed based on this fact and the lack of a study conducted with pre-service preschool teachers in this field. It is thought that this study, which aims to determine the thoughts of pre-service preschool teachers, who play an important role, especially in the preparation stage of students for the educational process, about writing to learn mathematics and the methods they use while writing, is important in terms of providing a framework in this regard. In this direction, the problem statement of the study was determined as "What are the thoughts of pre-service preschool teachers about writing to learn mathematics and the methods they use while writing". Within the scope of the problem statement, answers to the following sub-problems were sought:

1. What are the thoughts of pre-service preschool teachers about writing to learn mathematics?

2. Is there a significant difference between pre-service preschool teachers' thoughts about writing to learn mathematics and their gender and grade level?

3. What are pre-service preschool teachers' opinions about the methods they use while writing to learn mathematics?

4. Is there a significant difference between pre-service preschool teachers' opinions about the methods they use while writing to learn mathematics and their gender and grade levels?

Method

Research Design

Since the aim of the study was to determine the thoughts of pre-service preschool teachers about writing to learn mathematics and the methods they use while writing, the survey design, one of the quantitative research methods, was used. The survey design, which basically has a descriptive feature, is used to define the structure of individuals, societies, objects and institutions (Cohen et al., 2007; Özdemir, 2014). In this respect, survey studies, aim to determine the thoughts of a certain group regarding a subject or event and to determine the characteristics of the group such as attitudes, interests, perceptions, and abilities (Büyüköztürk et al., 2018).

Sample

The sample of the study consisted of a total of 418 pre-service teachers studying in preschool teaching undergraduate programs at eight different state universities. Demographic information about the sample is presented in Table 1.

Table 1. Demographic information about the sample

		Grade Level				
		1st Grade	2nd Grade	3rd Grade	4th Grade	Total
Gender	Male	25	16	10	13	64
	Female	119	82	88	65	354
	Total	144	98	98	78	418

As can be seen from Table 1, 144 of the 418 pre-service teachers who participated in the study are studying in the first grade, 98 in the second grade, 98 in the third grade and 78 in the fourth grade. In terms of gender, there are 64 male and 354 female pre-service teachers.

Data Collection Tool

A questionnaire is one of the most widely used data collection tools to determine the opinions of people on a research topic (Metin, 2014). Questionnaires are tools that enable the description of events, phenomena and experiences (Sönmez & Alacapınar, 2011) and are used to obtain information about any situation or attitude (Arıkan, 2013). In this study, a Likert-type questionnaire developed by Ozturk and Gunel (2015) to determine science teachers' use of writing and writing to learn purposes was used to collect data. This questionnaire consists of two main parts: the first part, which includes the personal information of science teachers, and the second part, which consists of 4 subsections with a total of 47 items independent of each other, including their perceptions towards writing and writing to learn purposes. In the second part of the questionnaire, teachers' agreement with the statements in the subsections created to determine their opinions about writing (section A-13 items) and their thoughts about their students' writing skills (section D-14 items) were graded between 1 and 5 (strongly disagree (1), disagree (2), undecided (3), agree (4) and strongly agree (5)). Again, in the second part of the questionnaire, teachers' agreement with the statements in the sub-sections created to determine the methods they use while writing (section B-12 items) and the types of writing they use in their classes (section C-8 items) were graded between 1 and 5 (never (1), very rarely (2), sometimes (3), frequently (4) and always (5)).

In this study, since it was aimed to determine pre-service preschool teachers' thoughts about writing to learn mathematics and the methods they used while writing, only sections A and B of the questionnaire were used. The Cronbach Alpha Reliability Coefficient of the questionnaire was calculated as 0.915 by Ozturk and Gunel (2015). Reliability is a characteristic of the data obtained

from the measurement tool, and it is not sufficient for the reliability of a scale to have been examined by the researchers who developed the scale or used it at different times. For this reason, it cannot be claimed that the relevant measurement tool will provide reliable data in every research based on the findings of past studies in which the scale was used (Bursal, 2017). Therefore, in this study, Cronbach's Alpha Reliability Coefficient was calculated using the data obtained from pre-service preschool teachers and it was found to be 0.737 for Part A, 0.764 for Part B and 0.751 for the whole questionnaire. Since it is recommended that Cronbach's Alpha Reliability Coefficient should be at least 0.70 in order for the data obtained in survey studies to be accepted as reliable (Büyüköztürk, 2011; Pallant, 2017; Seçer, 2017), it can be said that the data in this study are reliable.

Data Analysis

The data of the study were analyzed using the SPSS program. The analysis method used for each sub-problem in the analysis of the data is presented in Table 2.

Table 2. Data analysis methods used in the research

Sub-problem		Data analysis method
1st sub-problem		Frequency analysis
2nd sub-problem	By gender	Mann-Whitney U test
	By grade level	One-way analysis of variance (ANOVA)
3rd sub-problem		Frequency analysis
4th sub-problem	By gender	Mann-Whitney U test
	By grade level	One-way analysis of variance (ANOVA)

The type of data analysis used in the study was decided in line with the following explanations:

- In the analysis of the first and third sub-problems, frequency analysis, in which frequency and percentage values of each item in the questionnaire were created, was used in order to descriptively determine the thoughts of pre-service preschool teachers about writing to learn mathematics and the methods they use while writing.

- In the analysis of the second sub-problem, Mann-Whitney U Test, one of the nonparametric comparison tests, was used to determine whether there was a significant difference between pre-service preschool teachers' thoughts about writing to learn mathematics and their gender (Normality test result $p=0.002$ ($p<0.05$) and $p=0.001$ ($p<0.05$) for males and females respectively). In addition, in the analysis of the second sub-problem, ANOVA was used to determine whether there was a significant difference between pre-service preschool teachers' thoughts about writing to learn mathematics and their grade levels (Normality test results $p=0.155$ ($p>0.05$), $p=0.380$ ($p>0.05$), $p=0.184$ ($p>0.05$) and $p=0.200$ ($p>0.05$) for 1st, 2nd, 3rd and 4th grades respectively).

- In the analysis of the fourth sub-problem, Mann-Whitney U Test was used to determine whether there was a significant difference between pre-service preschool teachers' opinions about the methods they use when writing to learn mathematics and their gender since the normality test result

was p=0.200 (p>0.05) for men and had a normal distribution, but p=0.004 (p<0.05) for women and did not show a normal distribution. In addition, in the analysis of the fourth sub-problem, ANOVA was used to determine whether there was a significant difference between the thoughts of pre-service preschool teachers about the methods they use when writing to learn mathematics and their grade levels (Normality test results were p=0.200 (p>0.05), p=0.073 (p>0.05), p=0.068 (p>0.05) and p=0.215 (p>0.05) for 1st, 2nd, 3rd and 4th grades respectively).

Findings

In this section, the findings obtained from the data are presented under four headings in accordance with the sub-problems of the research.

1. Findings related to pre-service preschool teachers' thoughts about writing to learn mathematics

Table 3 presents the frequency and percentage values of the items (section A) that include pre-service preschool teachers' thoughts about writing to learn mathematics. In this section, noteworthy questionnaire items are explained by considering the sum of the percentages of agree and strongly agree statements.

Table 3. Frequency analysis related to pre-service preschool teachers' thoughts about writing to learn mathematics

Item	N	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
		f	%	f	%	f	%	f	%	f	%
A1. When writing about a particular topic, it is only important that the text contains all the ideas about the topic in a logical order.	408	24	5,9	116	28,4	77	18,9	154	37,7	37	9,1
A2. If someone asks me to write about a topic, I write because I want to write, not because I have to.	409	18	4,4	54	13,2	91	22,2	158	38,6	88	21,5
A3. A text is useful for everyone if it is well written in terms of content.	405	34	8,4	131	32,3	92	22,7	100	24,7	48	11,9
A4. I find it difficult to put my thoughts into writing, even though I have many ideas about what to write.	408	50	12,3	142	34,8	74	18,1	112	27,5	30	7,4
A5. Writing about a particular topic helps me to see the complexity of my thoughts on that topic.	413	4	1,0	16	3,9	43	10,4	258	**62,5**	92	**22,3**
A6. When I write a text, I focus only on the ideas that need to be conveyed.	408	25	6,1	142	34,8	85	20,8	131	32,1	25	6,1
A7. If I have a good background on the topic I need to convey, I can write the text easily.	412	5	1,2	11	2,7	36	8,7	217	**52,7**	143	**34,7**
A8. Writing helps me to understand what I am thinking.	413	1	0,2	15	3,6	25	6,1	236	**57,1**	136	**32,9**
A9. I may need more writing practice to write more effectively.	410	6	1,5	12	2,9	32	7,8	207	**50,5**	153	**37,3**
A10. Even if I have no knowledge of the topic I am writing about, I can generate ideas while writing because I have a good vocabulary	409	9	2,2	65	15,9	120	29,3	159	38,9	56	13,7
A11. Thinking about why I write helps me to improve my writing.	415	0	0,0	6	1,4	25	6,0	284	**68,4**	100	**24,1**
A12. When I am writing about a given topic, I can approach the topic in different ways to convince others of my ideas or to explain my ideas to others.	413	6	1,5	33	8,0	63	15,3	237	**57,4**	74	**17,9**

A13. Writing helps me to understand what I think about a certain topic.	415	3	0,7	14	3,4	43	10,4	261	**62,9**	94	**22,7**

When Table 3 is analyzed, it is seen that 84.8% of the pre-service teachers stated that writing about a certain subject helped them to see the complexity of their thoughts on that subject; 87.4% of them stated that they could write the text easily if they had a good background on the subject they needed to convey and 90% of them stated that writing helped them to understand what they thought about a certain subject. 87.8% of the pre-service teachers who participated in the survey stated that they may need more writing practice in order to write more effectively; 92.5% of them stated that thinking about why they write helps them improve their writing; 75.3% of them stated that when they write about a certain subject, they handle the subject in different ways in order to explain their ideas to others or to make them believe in their ideas; and 85.6% of them stated that writing helps them understand what they think about a certain subject.

2. Findings on the difference between pre-service preschool teachers' thoughts about writing to learn mathematics and their gender and grade level

The significance value between pre-service preschool teachers' thoughts about writing to learn mathematics and their gender was investigated by Mann-Whitney U Test and the results are presented in Table 4.

Table 4. Findings on the difference between pre-service preschool teachers' thoughts about writing to learn mathematics and their gender

	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	p
Part A of the questionnaire	Male	64	215,74	13807,50	10928,500	-0,450	0,653
	Female	354	208,37	73763,50			

When Table 4 is examined; since the calculated significance value is p>0.05, there is no significant difference between male and female pre-service teachers' thoughts about writing to learn mathematics (Mann-Whitney U=10928,500; Z=-0,450; p=0,653).

The significance value between pre-service preschool teachers' thoughts about writing to learn mathematics and their grade levels was investigated with (ANOVA) and Levene's Test result was calculated as p=0,407 (p>0,05) and the assumption of homogeneity of variances was met and the results are presented in Table 5.

Table 5. Findings on the difference between pre-service preschool teachers' thoughts about writing to learn mathematics and grade level

		Sum of Squares	df	Mean Square	F	p
Part A of the questionnaire	Between Groups	134,515	3	44,838	1,707	0,165
	Within Groups	10877,794	414	26,275		
	Total	11012,309	417			

When Table 5 is examined; since the calculated significance value is p>0,05, there is no significant difference between pre-service teachers' thoughts about writing to learn mathematics and their grade levels (F(3,414)=1,707; p=0,165).

3. Findings related to the methods used by pre-service preschool teachers when writing about learning mathematics

Table 6 presents the frequency and percentage values of the items (Part B) that include pre-service preschool teachers' opinions about the methods they use when writing to learn mathematics. In this section, noteworthy survey items are explained by taking into account the sum of the percentages of often and always expressions.

Table 6. Frequency analysis related to the methods used by pre-service preschool teachers when writing about learning mathematics

Item	N	Never		Very rarely		Sometimes		Frequently		Always	
		f	%	f	%	f	%	f	%	f	%
B1. I determine the purpose, topic and content of the text I write in advance.	411	1	0,2	9	2,2	76	18,5	200	**48,7**	125	**30,4**
B2. I create a draft before I start writing the text.	413	7	1,7	35	8,5	119	28,8	148	35,8	104	25,2
B3. I elaborated the draft according to the content of the topic.	412	5	1,2	27	6,6	96	23,3	189	**45,9**	95	**23,1**
B4. I design the changes I will make during the writing process.	415	5	1,2	26	6,3	146	35,2	155	37,3	83	20,0
B5. I do research on the topic before and/or during the writing process.	414	0	0,0	6	1,4	37	8,9	164	**39,6**	207	**50,0**
B6. I finish writing when I run out of ideas about the topic I am writing about.	410	21	5,1	41	10,0	154	37,6	140	34,1	54	13,2
B7. I usually take notes before I start writing.	410	8	2,0	24	5,9	76	18,5	168	41,0	134	32,7
B8. I always use predetermined criteria when deciding whether a written text is effective or not.	410	18	4,4	40	9,8	148	36,1	159	38,8	45	11,0
B9. To make sure that the text I have written is comprehensible, I have someone else read it to me.	411	15	3,6	45	10,9	99	24,1	132	32,1	120	29,2
B10. I reread the text I had written after finishing it.	416	3	0,7	5	1,2	12	2,9	106	**25,5**	290	**69,7**
B11. When I write, I keep in mind who I am writing to and/or why I am writing.	415	1	0,2	1	0,2	20	4,8	149	**35,9**	244	**58,8**
B12. If I need to write a long text, I write a few drafts before completing it.	408	12	2,9	27	6,6	102	25,0	153	37,5	114	27,9

When Table 6 is examined, it is seen that 79.1% of the pre-service teachers stated that they determine the purpose, subject and content of the text they write in advance; 69% of them elaborate on the draft they create before they start writing according to the content of the subject; 89.6% of them stated that they often or always do research on the subject they will write about before or during the writing process. Again, 95.2% of the pre-service teachers stated that they often or always reread the text after finishing it; 94.7% stated that they often or always keep in mind who they are writing to or why they are writing while writing.

4. Findings on the difference between pre-service preschool teachers' opinions on the methods they use when writing to learn mathematics and their gender and grade level

The significance value between pre-service preschool teachers' opinions about the methods they use while writing to learn mathematics and their gender was investigated by Mann-Whitney U Test and the results are presented in Table 7.

Table 7. Findings on the difference between pre-service preschool teachers' opinions on the methods they use when writing to learn mathematics and their gender

	Gender	N	Mean Rank	Sun of Ranks	Mann-Whitney U	Z	p
Part B of the questionnaire	Male	64	148,29	9490,50	7410,500	-4,411	0,001
	Female	354	220,57	78080,50			

When Table 7 is examined; since the calculated significance value is $p<0.05$, there is a significant difference between male and female pre-service teachers' opinions about the methods they use while writing to learn mathematics in favor of women (Mann-Whitney U=7410,500; Z=-4,411; p=0,001). In addition, the effect size value was calculated as 0.22. This value shows that the effect of significant difference is small. According to Cohen (1988, 1992), an effect size value between 0.1 and 0.3 indicates that the effect of significant difference is small.

The significance value between pre-service preschool teachers' thoughts about the methods they use while writing to learn mathematics and their grade levels was investigated with ANOVA and the Levene's Test result was calculated as $p=0.234$ ($p>0.05$) and the assumption of homogeneity of variances was met and the results are presented in Table 8.

Table 8. Findings on the difference between pre-service preschool teachers' opinions on the methods they use when writing to learn mathematics and grade level

		Sum of Squares	df	Mean Square	F	p
Part B of the questionnaire	Between Groups	3,630	3	1,210	0,033	0,992
	Within Groups	15070,466	414	36,402		
	Total	15074,096	417			

When Table 8 is examined; since the calculated significance value is $p>0,05$, there is no significant difference between pre-service teachers' opinions about the methods they use while writing to learn mathematics and their grade levels ($F(3,414)=0,033$; $p=0,992$).

Discussion, Conclusion and Recommendations

In Part A of the questionnaire, in which pre-service preschool teachers' thoughts about writing to learn mathematics were tried to be determined, the fact that most of the candidates stated that writing helped them to see the complexity of their thoughts on a subject and that writing helped them to understand what they thought about a certain subject show that they realized the revising writing process in Klein's (1999) theoretical study. Writing by revising allows individuals to see the complexity in their ideas, to make sense of their ideas and to form different ideas. In addition, revising helps individuals to organize their ideas, identify and eliminate contradictions in thoughts, and increase the retention time of complex information (Klein, 1999). The thoughts reflected by the candidates here are supported by the research that emphasizes that writing allows making sense of

ideas and helps to resolve complexity in ideas (Eryaman, 2008; Hand et al., 2007; Jaafar, 2016; Mason & Boscolo, 2000; Öztürk et al., 2022). On the other hand, the candidates stated that they could write the text easily if they had a good background on the subject and that they might need more writing practice in order to write effectively. Candidates also stated that thinking about what they wrote helped them to improve their texts and that when writing about a topic, they addressed the topic in a different way in order to explain their ideas to others or to convince them of their ideas. According to Flover and Hayes (1981), the writing process is a multifaceted process starting from the target audience, to the writing plan, to the revision and correction of the written text, and learning occurs as a result of the strong relationship between these elements in this process. Therefore, these thoughts of the candidates about writing to learn mathematics show that they use writing as a learning tool in their own writing process. Moreover, the statements of the candidates also reveal that they evaluate writing as a process. In this respect, it can be said that the candidates used Klein's higher-level writing hypotheses. The results obtained in this part of the study are similar to the results of the study conducted by Ozturk and Gunel (2015) with prospective science teachers. In that study, science teachers followed the writing process by revising, just like the pre-service preschool teachers in this study. Similarly, the results of the study are also in line with the study conducted by Öztürk et al. (2016a) with mathematics teachers and Öztürk et al. (2016b) with prospective mathematics, classroom, science, and social studies teachers. Considering the lack of a study conducted with preschool teachers or pre-service teachers, the study is important in terms of revealing the views of pre-service preschool teachers on writing to learn mathematics.

There was no significant difference between pre-service preschool teachers' views on writing to learn mathematics and their gender and grade level. When this result is evaluated, it is seen that the opinions of both male and female pre-service preschool teachers studying at different grade levels about writing to learn mathematics are similar. This situation reveals that gender is not an important variable in perceiving the importance of writing since the thoughts of female and male pre-service preschool teachers about writing to learn mathematics are similar. On the other hand, the fact that the pre-service teachers had similar opinions in terms of their grade levels also reflects that the grade level is not a distinctive variable in terms of their opinions on writing to learn mathematics. The fact that pre-service teachers at all grade levels have similar thoughts on this issue is also pleasing in terms of the fact that writing is seen as a learning tool for all levels and that the processes they carry out in their writing practices point especially to writing by revising. Because writing by revising requires high-level thinking. Since high-level thinking is considered to be very important for the development of the individual in the learning process, it is thought that it is important that the opinions of the candidates do not differ according to the variables. Moreover, the fact that gender and grade level have not been addressed before in national studies conducted to determine the thoughts about writing can be considered as an aspect that distinguishes this research from others.

The results obtained from Part B of the questionnaire, in which the methods used by pre-service preschool teachers while writing to learn mathematics were tried to be determined, showed that most of the candidates determined the purpose, subject and content of the text they wrote in advance, elaborated the draft they created before they started writing according to the content of the subject, did research on the subject they were going to write about before or during the writing process, reread the text after finishing it, and kept in mind who or why they were writing to while writing. The statements of the candidates in this section of the questionnaire show that they used the planned writing process, one of Klein's (1999) writing hypotheses. In planned writing, individuals who perform the act of writing determine their discourse goals, that is, their objectives to express their thoughts effectively, they set sub-goals related to the subject or content to fulfill these goals, and they develop the content to realize these sub-goals (Bitir & Duran, 2021; Kayaalp, 2021; Klein, 1999; Ozturk & Gunel, 2015). From this perspective, it can be said that planned writing provides a metacognitive blueprint for the learning process. Compared to the other three writing hypotheses in Klein's (1999) writing hypothesis (unplanned writing, writing by revising and writing by establishing relationships between text elements), planned writing is quite comprehensive in terms of requiring the most complex and advanced writing strategies (Biber, 2012; Klein, 1999). From this point of view, it is thought that it is important for candidates to carry out a comprehensive writing process in the methods they use while writing. On the other hand, to elaborate on the related results in detail, for example, the fact that the candidates kept in mind who or why they were writing while writing indicates that they used different languages according to different interlocutors and handled the text in different ways according to different purposes. It can be concluded that candidates use different writing methods for various purposes such as presenting their background on a topic or exploring their thoughts, taking into account the characteristics of the person to whom they will present the text. Considering different interlocutors while writing is seen as an important component since it enables individuals to use a different language (Hand et al., 2007). In addition, considering different interlocutors and planning the act of writing allow individuals to construct their understanding of the subject (Hohenshell et al., 2004). Therefore, it is possible to say that the orientations of the candidates in the methods they use for learning mathematics are positive. The results obtained are in parallel with the results of the studies conducted by Ozturk and Gunel (2015) with science teachers, Öztürk et al. (2016a) with mathematics teachers, and Öztürk et al. (2016b) with prospective mathematics, classroom, science and social studies teachers. It is thought that the results of the study are important in terms of supporting the results of these studies and revealing the thoughts of pre-service preschool teachers, which is a different branch and has not been researched before.

Although the effect size was small, there was a significant difference between pre-service preschool teachers' opinions about the methods they use while writing to learn mathematics and the gender variable. From this point of view, it is possible to say that the methods used by female and

male pre-service preschool teachers while writing to learn mathematics differ. On the other hand, there was no significant difference between the pre-service preschool teachers' opinions about the methods they use while writing to learn mathematics and their grade levels. It can be inferred that grade level is not an important variable in terms of the methods used in writing to learn mathematics. The fact that the methods used by pre-service teachers at all grade levels are similar and especially that this similarity is in the direction of the planned writing hypothesis indicates that they have formed a good infrastructure on this subject until they come to undergraduate education. Considering that planned writing provides a metacognitive outline for the learning process, it is important that the opinions of the candidates do not differ according to the grade level. Again, the fact that gender and grade level have not been studied before in national studies on the methods used in writing reveals the difference between this study from the studies in the literature.

The fact that the number of female candidates is significantly higher than male candidates in the sample distribution in this study points to the limitation of the results of the study. Therefore, it may be recommended to repeat the study on samples with a more homogeneous distribution. In addition, in sections A and B of the questionnaire, it is seen that the candidates reflected that they used revised writing and planned writing processes from Klein's (1999) writing hypotheses. However, the extent to which they put these writing hypotheses into action in practice can be determined by conducting practical writing studies with the candidates. Thus, the consistency between the candidates' thoughts and actions can be interpreted.

Policy Implications

It is seen that countries have made a revision in their education-training approaches since the effects of the constructivist approach began to increase. Especially in today's understanding of education, the emphasis is not on individuals taking the information given verbatim and accepting it, but on making the information meaningful by going through their own mental processes. Moreover, in today's education approach, it is thought that rather than determining the knowledge level of individuals, it is important for the information they acquire to become experiential and meaningful for them. Considering the relevant literature framework, it is noteworthy that writing and WTL contribute to the meaningful learning of individuals, allow them to express and compare their ideas, and in this respect, are a good learning tool. When evaluated from this perspective, writing and WTL are widely used and examined in field education, especially in international literature. In our country, while many approaches, methods and techniques are addressed as research topics to enrich learning outcomes and support individual development, it can be said that writing and WTL in this sense have received limited attention in the national literature and studies have gained momentum, especially in recent years. Considering that writing and WTL are the focus of attention in the international literature, that it has gained momentum in the national literature in recent years, and the results of these studies, the

importance of writing for educational practices and WTL is understood. Writing and WTL support the mental development of individuals and make the information they acquire meaningful. It is known that education policies are shaped by closely examining educational approaches both nationally and internationally. It is also emphasized that different teaching methods, techniques, models and approaches should be used in the education process and practices, taking into account the development of individuals in education policies. It is also recommended that individual differences be taken into account in today's education policies. In this regard, considering its content and effects on the individual, it can be said that writing and WTL is a teaching practice that supports today's education policies. Moreover, the fact that this study presents a broad literature framework on writing and WTL and that no study has been found on the thoughts of pre-service preschool teachers is thought to be important in terms of providing a draft for program development studies and educational policies.

Conflict of Interest

No conflicts of interest is declared by the author.

Funding Details

No funding or grant was received from any institution or organization for this research.

Ethical Statement

Ethics committee approval has been obtained from the Bayburt University Ethics Committee of Scientific Research with the decision numbered E-79126184-050.99-11716 on 30.03.2021.

Credit Author Statement

The author confirms that he had all responsibilities for the following: conceptualization of the study and design, data collection, data analysis and interpretation of the findings and preparation of the manuscript.

Acknowledgement

I would like to thank Assist. Prof. Dr. Bilge ÖZTÜRK for her assistance in the data collection process of this study.

References

Arıkan, R. (2013). *Anketler ve anket soruları* (1. Baskı). Nobel Yayıncılık.

Biber, B. (2012). *Science teachers' perceptions toward writing and levels of writing-to-learn implementations* [Master thesis]. Atatürk University. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/

Bitir, T., & Duran, E. (2021). Development of a rubric to evaluate the critical writing skills levels of fourth-grade primary school students. *Educational Policy Analysis and Strategic Research, 16*(4), 255-273. https://doi.org/10.29329/epasr.2021.383.14

Bursal, M. (2017). *SPSS ile temel veri analizleri.* Anı Yayıncılık.

Büyüköztürk, Ş. (2011). *Sosyal bilimler için veri analizi el kitabı* (15. Baskı). Anı Yayıncılık.

Büyüköztürk, Ş., Kılıç-Çakmak, E., Akgün, Ö. A., Karadeniz, Ş., & Demirel, F. (2018). *Bilimsel araştırma yöntemleri* (24. Baskı). Pegem Akademi Yayıncılık.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd Ed.). Academic Press.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112*(1), 155-159. Retrieved from http://users.cla.umn.edu/~nwaller/prelim/cohenpowerprimer.pdf

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education*. Routhledge.

Çömen, H., & Uzun, S. (2022). The effect of a hybrid book based on the writing to learn activities supported learning environment on student achievement. *Gazi University Journal of Gazi Education Faculty, 42*(1), 461-483. https://doi.org/10.17152/gefad.748685

Demir, T. (2013). Study of the relationship between the creative writing skills of primary school students and their self-efficacy perception. *International Journal of Turkish Literature Culture Education, 2*(1), 84-114.Retrieved from https://dergipark.org.tr/en/pub/teke/issue/12845/155637

Demirbağ, M. (2011). *The effect of multi modal instruction on student's science achievement and writing skills in an argument based inquiry classroom* [Master thesis]. Ahi Evran University. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/

Demirbağ, M., Kingir, S., & Çepni, S. (2015). The relationship between prospective teachers' belief systems and writing-to-learn. *Ahi Evran University our nal of Kırşehir Education Faculty, 16*(2), 423-442. Retrieved from https://dergipark.org.tr/en/pub/kefad/issue/59450/854123

Doğan, Y., & İlhan, N. (2016). Prospective teachers' views related to using writing to learn activities in "science and technology teaching" course. *Adıyaman University ournal of Educational Sciences, 6*(1), 1-22. https://doi.org/10.17984/adyuebd.30690

Drowns-Bangert, R.L., Hurley, M.M., & Wilkinson, B. (2004). The effects of school-based writing-to-learn interventions on academic achievement: A meta-analysis. *Review of Educational Research, 74*(1), 29-58. https://doi.org/10.3102/00346543074001029

Eryaman, M.Y. (2008). Writing, method and hermeneutics: Towards an existential pedagogy. *İlköğretim Online*, *7*(1), 2-14.

Flower, L., & Hayes, J.R. (1981). A cognitive process theory of writing. *College Composition and Communication, 32*(4), 365-387. https://doi.org/10.2307/356600

Galbraith, D., Ford, S., Walker, G., & Ford, J. (2005). The contribution of different components of working memory to planning in writing. *L1-Educational Studies in Language and Literature,15*, 113-145. https://doi.org/10.1007/s10674-005-0119-2

Glen, N.J. (2008). *Writing in elementary school science: Factors that influence teacher beliefs and practices* [Doctoral dissertation]. Syracure University.

Graham, S. (2008). Research on writing development, practice, instruction, and assessment: Introduction to a special issue of reading and writing. *Read Write*, *21*, 1-2. https://doi.org/10.1007/s11145-007-9069-7

Günel, M. (2009). Writing as a cognitive process and learning tool in elementary science education. *Elementary Education Online, 8*(1), 200-211. Retrieved from https://dergipark.org.tr/tr/pub/ilkonline/issue/8599/107061

Gunel, M., Hand, B., & McDermott, M. (2009). Writing for different audiences: Effects on high school students' conceptual understanding of biology. *Learning and Instruction, 19*, 354-367. https://doi.org/10.1016/j.learninstruc.2008.07.001

Gunel, M., Hand, B., & Prain, V. (2007). Secondary analysis of non-traditional writing in science across different grade-levels. *International Journal of Science and Mathematics Education, 4*(5), 615-637.

Hand, B., & Prain, V. (2002). Teachers implementing writing-to-learn strategies in junior secondary science: A case study. *Science Education, 86*(6), 737-755. https://doi.org/10.1002/sce.10016

Hand, B., Hohenshell, L., & Prain, V. (2007). Examining the effect of multiple writing tasks on year 10 biology students' understanding of cell and molecular biology concepts. *Instructional Science, 35*, 343-373. https://doi.org/10.1007/s11251-006-9012-3

Hand, B., Yang, O.E.M., & Bruxvoort, C. (2007). Using writing-to-learn science strategies to improve year 11 students' understandings of stoichiometry. *International Journal of Science and Mathematics Education*, 5, 125-147. https://doi.org/10.1007/s10763-005-9028-1

Hohenshell, L., Hand, B., & Staker, J. (2004). Promoting conceptual understanding of biotechnology: Writing to a younger audience. *The American Biology Teacher, 66*(5), 333-338. https://doi.org/10.2307/4451686

Jaafar, R. (2016). Writing-to-learn activities to provoke deeper learning in calculus. *Problems, Resources, and Issues in Mathematics Undergraduate Studies, 26*(1), 67-82. https://doi.org/10.1080/10511970.2015.1053642

Kabataş-Memiş, E. (2014). Students' views about the non-traditional writing. *Procedia-Social and Behavioral Sciences, 116*(2014), 1735-1738. https://doi.org/10.1016/j.sbspro.2014.01.464

Kayaalp, F. (2021). *The effect of using writing to learning activities in social studies course on cognitive and affective learning* [Doctoral dissertation]. Atatürk University. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/

Klein, P.D., & Rose, M.A. (2010). Teaching argument and explanation to prepare junior students for writing to learn. *Reading Research Quarterly, 45*(4), 433-461. https://doi.org/10.1598/RRQ.45.4.4

Klein. D.P. (1999). Reopening inquiry into cognitive processes in writing-to-learn. *Educational Psychology Review, 11*(3), 203-270. https://doi.org/10.1023/A:1021913217147

Klein, D.P. (2000). Elementary students' strategies for writing-to-learn in science. *Cognition and Instruction, 18*(3), 317-348. https://doi.org/10.1207/S1532690XCI1803_2

Mason, L., & Boscolo, P. (2000). Writing and conceptual change. What changes?. *Instructional Science, 28*, 199-226. https://doi.org/10.1023/A:1003854216687

Metin, M. (2014). Nicel veri toplama araçları. M. Metin (Ed.), *Kuramdan uygulamaya eğitimde bilimsel araştırma yöntemleri* içinde (s. 161-214). Pegem Akademi.

Oz, M., & Kabatas-Memis, E. (2018). Effect of multi modal representations on the critical thinking skills of the fifth grade students. *International Journal of Progressive Education, 14*(2), 209-227. https://doi.org/10.29329/ijpe.2018.139.15

Ozturk, B., & Gunel, M. (2015). Writing and its use as a learning tool through teacher's perspective: Instrument development and a pilot implementation. *Elementary Education Online, 14*(2), 713-733. https://doi.org/10.17051/io.2015.60822

Özdemir, Ö. (2014). Tarama yöntemi. M. Metin (Ed.), *Kuramdan uygulamaya eğitimde bilimsel araştırma yöntemleri* içinde (s. 77-97). Pegem Akademi Yayıncılık.

Öztürk, B., Kaymakoğlu, H., & Demiroğlu-Çiçek, S. (2022). The effect of writing to learn activities on the academic achievement of 8th grade students on periodic system. *Journal of Science Teaching, 10*(1), 115-138. https://doi.org/10.56423/fbod.1097724

Öztürk, B., Öztürk, F., & Işık, A. (2016b). An investigation into the perspectives of prospective teachers on writing and writing to learn activities. *Turkish Journal of Social Research*, (Special issue), 1-15. Retrieved from https://dergipark.org.tr/tr/download/journal-file/20653

Öztürk, F., Öztürk, B., & Işık, A. (2016a). The opinions of secondary school mathematics teachers on writing and writing-to-learn activities. *Journal of Bayburt Education Faculty, 11*(2), 306-328. Retrieved from https://dergipark.org.tr/en/pub/befdergi/issue/28762/307844

Pallant, J. (2017). *SPSS kullanma kılavuzu: SPSS ile adım adım veri analizi* (2. Baskı) (S. Balcı & B. Ahi, Çev.). Anı Yayıncılık (Orijinal eserin basım tarihi 2016, 6. Baskı).

Prain, V., & Hand, B. (2006). Science and literacy. In K. Appleton (Ed.), Elementary science teacher education: Issues and practice (pp. 153-174). Association of Educators of Science Teachers Publication, Lawrence Erlbaum Associates, Inc.

Rivard, L.P., & Straw, S.B., (2000). The effect of talk and writing on learning science: An exploratory study. *Science Education*, 84, 566-593. https://doi.org/10.1002/1098-237X(200009)84:5<566::AID-SCE2>3.0.CO;2-U

Seçer, İ. (2017). *SPSS ve ISRE ile pratik veri analizi: Analiz ve raporlaştırma* (3. Baskı). Anı Yayıncılık.

Sedita, J. (2015). Learning to write and writing to learn. In M.C. Hougen (Ed.), *Fundamentals of literacy instruction and assessment: 6-12,* (pp. 97-115). Brooks Publishing Company.

Sinaga, P., & Feranie, S. (2017). Enhancing critical thinking skills and writing skills through the variation in non-traditional writing task. *International Journal of Instruction, 10*(2), 69-84. Retrieved from https://eric.ed.gov/?id=EJ1138333

Sönmez, V., & Alacapınar, F. (2011). *Örneklendirilmiş bilimsel araştırma yöntemleri*. Anı Yayınları.

Tynjala, P. (1998). Writing as a tool for constructive learning: Students' learning experiences during an experiment. *Higher Education, 36*, 209-230. https://doi.org/10.1023/A:1003260402036

Van Dijk A., Van Gelderen A., & Kuiken, F. (2022). Effects of instruction in writing-to-learn on low-achieving adolescents in biology and mathematics classes. *Education Sciences*, *12*(9), 1-25. https://doi.org/10.3390/educsci12090595

Wallace, C., Hand, B., & Prain, V. (2004). *Writing and learning in the science classroom*. Kluiwer Academic Publishers.

Watts, F.M., Park, G.Y., Petterson, M.N., & Shultz, G.V. (2022). Considering alternative reaction mechanisms: students' use of multiple representations to reason about mechanisms for a writing-to-learn assignment. *Chemistry Education Research and Practice, 23,* 486-507. https://doi.org/10.1039/D1RP00301A

Wright, K.L., Hodges, T.S., Zimmer W.K., & McTigue, E.M. (2019). Writing-to-learn in secondary science classes: for whom is it effective?. *Reading & Writing Quarterly, 35*(4), 289-304. https://doi.org/10.1080/10573569.2018.1541769

Yıldırım, A., Doğanay, A., & Türkoğlu, A. (2009). *Okulda başarı için ders çalışma ve öğretme yöntemleri* (2. Baskı). Seçkin Yayıncılık.