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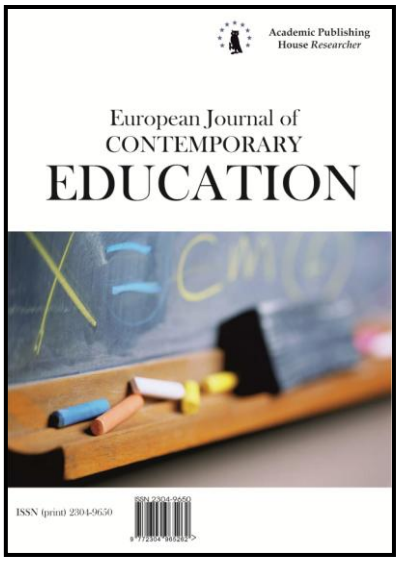

An Investigation into the Perceptions of Mathematics and Information Literacy Self-Efficacy Levels of Pre-Service Primary Mathematics Teachers

Bahar Dinçer [a, *], Süha Yılmaz [b]

[a] Department of Elementary Mathematics Teacher Education, Dokuz Eylül University, Turkey
[b] Department of Mathematics Education, Dokuz Eylül University, Turkey

Abstract

The purpose of this study is to examine the relationship between perceptions of the self-efficacy levels for both mathematics literacy and information literacy in pre-service primary mathematics teachers and the factors on which the relationship depends (variables include gender, class level, hours spent reading books and computer-access facilities). The research model is a relational-survey model of the quantitative patterns. According to the results, it was determined that there was a positive relationship between perceptions of the self-efficacy levels of mathematics literacy and information literacy in pre-service teachers. Separately, it was ascertained that mathematics literacy self-efficacy levels in pre-service teachers showed meaningful differences according to variables such as class level and book-reading frequency/rate, whereas their information literacy self-efficacy levels depended on variables such as gender and computer-access status. According to these results, when considering the factors influencing literacy levels, it is seen that the variables such as computer-access status and book-reading frequency/rate are significant in terms of the pre-service teachers having these positive features. In addition, for future researches it can be examine the relationship between perceptions of the self-efficacy levels for both mathematics literacy and information literacy in in-service primary mathematics teachers and the different factors on which the relationship depends.

Keywords: information literacy, mathematics literacy, literacy, perception of literacy self-efficacy.

[*] Submitted the manuscript on November 30, 2015.
E-mail addresses: bahardincer87@hotmail.com (Bahar Dinçer), suha.yilmaz@deu.edu.tr (Süha Yılmaz)

Introduction

The concept of literacy is based on the ability to use verbal, written and visual communicative systems in an efficient way. The word, 'literacy', is also added to the terms of different fields, apart from its meaning as regards functional literacy, such as computer literacy, graphics literacy, environmental literacy, economics literacy, legal literacy, library literacy, digital literacy, political literacy, technology literacy, consumer literacy, media literacy, critical literacy, citizenship literacy and web literacy. The word, 'literacy', within the terms in question, signifies the possession of basic knowledge and skills in a given field (Snavely and Cooper, 1997, p. 12). Considering this in terms of educational teaching/training, on the other hand, it is important to constitute efficient teaching-learning environments (and to organize various events and activities) as multiple literacies in order to enable individuals to possess the characteristics of literacy (Ersoy, 1997). The term, 'information literacy', which is the first of the abovementioned types of literacy that is analysed in this study, was first used in the USA in 1974, and was included in a report in a simple way by Paul Zurkowski (1974), the President of the US Association of Information Industry at the time, who defined it as: "Educating individuals in order to enable them to use their information resources involving their jobs". Although a number of definitions were made later, a broadly used definition of information literacy was developed by the Association of the American Library (AAL). According to this definition, information literates are individuals who have already learned how to learn. The reason that they have mastered the learning process is that they know how information is organized and how to access information, as well as being able to arrange that information in a way that enables others to learn. However, it is accepted that mathematics literacy, the second type of literacy discussed here, does not only comprise skills such as reading, writing and performing digital processes/operations in line with current changes and innovations within the concept of literacy in general (Özgen and Bindak, 2011). Mathematics literacy was defined by the OECD (2006) as: "The capacity of an individual to understand, acknowledge and recognize the role of mathematics in the world around him/her by using the thinking and decision-making processes in solving the problems to be encountered today and in the future as a citizen who is capable of thinking, producing and criticizing".

Considering this in terms of mathematics education and teaching, on the other hand, teachers should educate their students in such a way that they are allowed to question what has been learned, by guiding them towards acquiring a deep understanding of the subject in order to develop their mathematics-literacy levels (Edge, 2003).

A number of studies associate information literacy with other types of literacy. Spitzer, Eisenberg and Lowe (1998) associated information literacy with visual literacy, media literacy, computer literacy and web literacy. While Curzon (1995) defined information literacy as the combination of library literacy, computer literacy, media literacy and technology literacy; McLure(1994), similarly, defined information literacy as a concept including computer literacy, media literacy and web literacy, but also, most notably, functional literacy (Jager and Nassimbeni,2002). Including the use of computers within information literacy turned the discipline into one with a broadening spectrum, including factors from social, cultural and even philosophical content to the effects posed by these aspects, including access to information (Shapiro and Hughes, 1996).

One result of these definitions, on the other hand, is that the primary condition for reaching the desired level in all types of literacy is to become information literate to a sufficient level. Considering this issue in terms of the teaching profession, which entails a learning process lasting a lifetime for the sake of professional development, Akkoyunlu (2008) established the relationship between information and the lifetime-learning process by starting from the importance of information in his study "Information Literacy and Lifetime Learning". He also explained the strategic and correlatively empowering relationship between information literacy and lifetime learning. As for mathematics literacy, there are several studies of secondary-school students for the purpose of the Programme for International Student Assessment (PISA) practices. Tekin and Tekin (2004), in a study conducted along with pre-service teachers, aimed to determine the literacy levels of mathematics pre-service teachers of primary education. As a result of the study, it was determined that the mathematics-literacy levels of the mathematics pre-service teachers proved to be at an average level in general. Papanastasiou and Ferdig (2006), however, investigated both

current and potential relationships between the use of computers and mathematics literacy. Although, according to a number of studies, there was a significant relationship between the use of computers and information literacy, it was found that there was a relationship between mathematics-literacy levels and the various activities of computer usage.

Even though literacy skills always stand to be improved, societies lose reading habits acquired in previous periods as a result of the strengthening of the visual mass media; an unfortunate consequence is that they become unable to fulfil literacy tasks (Lester, 2006). Along with such losses, raising individuals with literacy skills and the ability to question the quality of information at each stage of their educational lives are priorities that are gathering more prominence. In this respect, analysing different types of literacy possessed by teachers in terms of different variables can help show which variables affect literacy skills. In this way, literacy levels can be raised by positively influencing these variables.

As a result of the research carried out, literacy is conceived as a set of skills. Information skills include being aware of information requirements, as well as being able to define it; developing information-seeking strategies; searching for information, as well as using and evaluating it; integrating new information with existing information, as well as transferring it. Mathematical skills, such as being able to reason, problem solve, think analytically and critically and being able to synthesize material, are all expected to be at high levels in teachers and pre-service teachers. They are the primary societal architects, particularly in terms of literacy levels acquired during a period in which science and technology are affecting human life quite intensely. According to the Annex of a Recommendation of the European Parliament and Of The Council (2006) (Key Competences For Lıfelong Learnıng — A European Reference Framework), The Reference Framework sets out eight key competences:Communication in the mother tongue,Communication in foreign languages;Mathematical competence and basic competences in science and technology; Digital competence;Learning to learn;Social and civic competences;Sense of initiative and entrepreneurship; Cultural awareness and expression. The key competences are all considered equally prominent, because each of them can support to a successful life in a knowledge society. Competence in the fundamental basic skills of language, literacy, numeracy and in information and communication technologies (ICT) is an necessary foundation for learning, and learning to learn supports all learning activities. But two of these key competences (Mathematical competence/basic competences and leraning to learn) are directly related to mathematics and information literacy. It is thought that primary teachers have to possess such skills and literacy self-efficacy so that students can acquire mathematical and information literacy skills, which are essential in the educational process.

Also, when the TIMMS data was analysed in terms of teacher characteristics, it was observed that 30% of eighth grade mathematics teachers who participated in the TIMMS 2011 study in Turkey have participated in professional development activities in the field of mathematical subjects within the last two years. Regarding international average, the mathematics teachers of 55% of students have participated in professional development activities in the field of mathematical subjects within the last two years. It was determined that teachers who attended the training in the field of mathematical subjects were found the most in Israel (79%), whereas they were found the least in Finland (9%). It was also determined that the students of teachers who have participated in professional development activities have higher rates of success. When teacher characteristics were analysed in terms of their self-confidence regarding mathematics education, it was observed that the teachers of 65% of students who took the test in Turkey have a high self-confidence regarding their status in mathematics lectures, whereas the teachers of the remaining 35% have partial self-confidence. The success average of the students of teachers who have a high self-confidence in situations that may be encountered during mathematics lessons was 461; whereas the students of teachers with partial self-confidence had an average of 436. Regarding international averages, 76% of teachers had very high self-confidence regarding mathematics education, and the mathematics success average of their students was found to be 470. It was observed that, as the confidence level of mathematics teachers increases, the success average of their students increases as well. The information and mathematics literacy levels contained in this study are important both for professional development and self-confidence of teacher candidates. Studies have shown that the preparedness and professional qualities of the teacher are more predictive of success regarding the cognitive and affective properties of the student. For this

reason, the primary aim is to determine the competency of teachers.(Büyüköztürk et al., 2011). This study was conducted in the light of this information, and aimed at analysing the self-efficacy perceptions of the primary-school mathematics pre-service teachers during their path through the teaching profession. It also sought to determine the extent to which mathematics and information literacy is effective in developing the literacy skills of students, analysing the phenomenon in terms of several variables and investigating the relationships between those variables.

Method

In line with the stated objective, the problem of the research is as follows: "What is the relationship between perceptions of the self-efficacy levels of mathematics literacy and information literacy in pre-service primary mathematics teachers?". In addition, it was examined whether these perceptions altered according to the variables of gender, social class, book-reading frequency/rate, Internet-access facilities and the duration of computer usage.

The research model is a relational-survey model of the quantitative patterns used, in order to examine the relationship between the perceptions of mathematics and information literacy self-efficacy levels of pre-service primary mathematics teachers, and the factors on which such literacies depend. The survey model is an approach that aims to reveal the status of a phenomenon in either the past or the present. The individual, object or another event is the subject of the study, defined as it is within its own conditions and without any intervention (Karasar, 2009).

This research project was carried out with the cooperation of 127 pre-service teachers attending the 2015 Summer School of Dokuz Eylul University, Buca Faculty of Education, Department of Elementary Mathematics Education.

During the research, two data-collecting tools were used. The scales used in this respect are the perceptions of mathematics literacy self-efficacy scale, and the perceptions of information literacy self-efficacy scale. "The perceptions of mathematics literacy self-efficacy scale", developed by Özgen and Bindak (2008), aims to measure belief in one's own self-efficacy in mathematics literacy. The five-point Likert scale consists of a total of 25 items, four of which are negative, and includes the options, 'Totally Agree', 'Agree', 'Not Sure', 'Do not Agree' and 'Totally Disagree'.

It was reported that the item-total score correlations of the scale varied between 0.48 and 0.75, and that Cronbach's alpha reliability-coefficient was calculated as 0.94. The lowest score to be obtained from the scale is 25, whereas the highest is 125. The highest score to be obtained from the scale was based on the acceptance that the self-efficacy levels of the pre-service teachers as regarding mathematics literacy were at high levels. The reliability coefficient of this scale in this research was found to be 0.83.

On the other hand, "The perceptions of information literacy self-efficacy scale", developed by Kurbanoğlu and Akkoyunlu (2004), is a seven-point Likert scale involving the following options: 7= 'I trust myself quite a lot', 4= 'I am not sure' and 1= 'I do not trust myself at all'. The Cronbach's alpha value of this scale, arranged in the form of 28 items, was determined to be 0.92. The mean scores obtained from the self-efficacy scale of information literacy were classified as high if they proved to be between 5 and 7, average if they were between 3 and 4.99 and low if they were less than 2.99. Furthermore, as the result of this research, the reliability of the information-literacy scale was recalculated, and the Cronbach's alpha value was found to be 0.93.

In the data analysis — according to the Kolmogorov-Smirnov analysis results, indicating whether or not the scores that the pre-service teachers obtained from the scales were in compliance with the normal distribution — the scores of the pre-service teachers were obtained from the perceptions of the mathematics literacy self-efficacy scale ($K\text{-}S_{maths}=1.019$, $p=0.250$). Those obtained from the perceptions of the information literacy self-efficacy scale ($K\text{-}S_{information}=0.955$, $p=0.322$) were seen to have complied with the normal distribution. According to the variables found in the section detailing the pre-service teachers' personal information, it was found that all of the distributions were homogeneous and in accordance with the Levene's test result. That test was performed for the purpose of determining the differentiation status between their self-efficacy scores for mathematics and information literacy. During the study, parametric-test methods were used, since the conditions for normality and variance homogeneity that are required for performing the parametric tests were ensured.

In order to put forward the differentiation status of the pre-service teachers' self-efficacy perceptions for information and mathematics literacy in accordance with the variables (such as

book-reading frequency/rate and the duration of computer usage), a one-way analysis of variance (ANOVA) was calculated by using the SPSS program. A t-test was performed, however, for the independent groups in order to analyse the differentiation status according to gender, class and Internet-access facilities. On the other hand, the Pearson's correlation coefficient test was used for examining the relationship between the perceptions of self-efficacy in both information and mathematics literacy.

Findings

In this section, the pre-service primary mathematics teachers' perceptions of mathematics and information literacy self-efficacy levels are presented, besides the statistical analyses performed on the data obtained from the personal information forms. The personal information of the pre-service teachers who participated in the research is shown in Table 1.

Table 1. Personal Information of the Research Group

	f	%
Gender		
Female	76	59.8
Male	51	40.2
Class Level		
1st Grade	37	29.1
3rd Grade	90	70.9
Book-Reading Frequency/Rate		
Always	13	10.2
Quite often	21	16.5
Occasionally	65	51.2
Rarely	22	17.3
Never	6	4.7
Period of Computer Usage		
1–7 hours	37	29.1
8–21 hours	43	33.9
22–35 hours	26	20.5
Above 36 hours	21	16.5
Computer-Access Status		
Yes	107	84.3
No	20	15.7

The descriptive findings regarding the pre-service primary mathematics teachers' perceptions of mathematics and information literacy self-efficacy levels are shown in Table 2.

Table 2. The descriptive findings regarding the perceptions of mathematics and information literacy self-efficacy levels

	N	Mean	Max	Min	S.D
Mathematics literacy self-efficacy levels	127	89.01	115.0	65.0	9.95
Information literacy self-efficacy levels	127	127.00	167.0	71.0	20.42

As stated in the Method section, the perceptions of mathematics literacy self-efficacy was measured using a five-point Likert scale and the perceptions of information literacy self-efficacy was measured using a seven-point Likert scale. The mean of the perceptions of mathematics literacy self-efficacy levels was determined as x=89.01, while this average (according to the score range of the scale) was determined as corresponding to the answer 'Agree'. When the views of the pre-service teachers as to the items of the mathematics literacy self-efficacy scale were reviewed, it

was found that the item with the highest score was, 'I trust myself in performing any sort of digital operation' (x=3.88), whereas the item with the lowest score was, 'I fail to notice the mathematical relations in current events' (x=3.06). On the other hand, the mean of their perceptions of information literacy self-efficacy levels was determined as x=127. Considering the score range of the scale, it can be concluded that the pre-service teachers, according to this average, perceive themselves to have an average level of information literacy self-efficacy. When the views of the pre-service teachers regarding the items within the perceptions of information literacy self-efficacy scale were reviewed, it was found that the item with the highest score is 'Interpreting visual information' (tables, graphics, etc.) (x=5.58), and the item with the lowest score is 'Using different libraries' (x=4.66).

Table 3. Comparison of the literacy scores of the pre-service teachers according to gender

Dimension	Gender	N	X	S.D	p
Mathematics literacy	Male	51	88.25	10.28	0.48
	Female	76	89.52	9.76	
Information literacy	Male	51	121.68	21.32	0.016
	Female	76	130.57	19.11	

The mean score obtained from the perceptions of mathematics literacy self-efficacy scale for the male pre-service teachers proved to be lower ($\overline{X}$ =88.25) than that of the female pre-service teachers ($\overline{X}$ =89.52). The fact that the significance level of the 'p' value (0.48) was greater than 0.05 suggests that there is no significant relationship between gender and self-efficacy perceptions as to mathematics literacy.
On the other hand, the perceptions of the female pre-service teachers regarding the information literacy self-efficacy scale were found to be higher ($\overline{X}$ =130.57) than those of the male pre-service teachers ($\overline{X}$ =121.68). The fact that the significance level of the 'p' value (0.016) was smaller than 0.05 suggests that there is a significant relationship between gender and perceptions of self-efficacy in information literacy.

Table 4. Comparison of the literacy scores of the pre-service teachers according to class

Dimension	Class level	N	X	S.D	p
Mathematics literacy	1	37	85.94	9.24	0.025
	3	90	90.27	10.01	
Information literacy	1	37	124.89	16.95	0.456
	3	90	127.87	21.71	

The mathematics literacy self-efficacy scores of the pre-service teachers belonging to the third grade proved to be higher ($\overline{X}$ =90.27) than those of the pre-service teachers belonging to the first grade ($\overline{X}$ =85.94). The fact that the significance level of the 'p' value (0.025) was smaller than 0.05 suggests that there is a significant relationship between the class level and perceptions of self-efficacy in mathematics literacy. The fact that the significance level of the 'p' value (0.456) was greater than 0.05 suggests that there is no significant relationship between class levels and perceptions of self-efficacy in information literacy.

Table 5. Comparison of the literacy scores of the pre-service teachers according to their computer-access status

Dimension	Computer Access	N	X	S.D	p
Mathematics literacy	Yes	107	88.71	9.89	0.42
	No	20	90.65	10.37	
Information literacy	Yes	107	129.43	19.40	0.002
	No	20	114.00	21.32	

The fact that the significance level of the 'p' value (0.42) was greater than 0.05 suggests that there is no significant relationship between computer access and perceptions of self-efficacy in mathematics literacy. When information literacy is analysed, the fact that the significance level of the 'p' value (0.002) was smaller than 0.05 suggests that there is a significant relationship between computer-access status and perceptions of information literacy self-efficacy. The information literacy self-efficacy scores were seen to be higher in the pre-service teachers who had access to computers ($\overline{X}$ =129.43).

Table 6. Comparison of the literacy scores of the pre-service teachers according to the period of computer usage

Dimension	Period of Computer Usage	N	$\overline{X}$	S.D	d.f	F	P
Mathematics literacy	1–7 h	37	87.89	10.49	3–123	0.585	0.626
	8–21 h	43	90.32	9.21			
	22–35 h	26	87.76	9.09			
	Above 36 h	21	89.85	11.67			
Information literacy	1–7 h	37	128.05	24.59	3–123	0.126	0.945
	8–21 h	43	126.37	18.85			
	22–35 h	26	128.07	16.44			
	Above 36 h	21	125.14	21.14			

The fact that the significance levels of the 'p' value (0.626–0.945) were greater than 0.05 suggests that there is no significant relationship between the perceptions of mathematics and information literacy self-efficacy and the duration/period of computer usage.

Table 7. Comparison of the literacy scores of the pre-service teachers according to book-reading frequency/rate

Dimension	Book-Reading Rate	N	$\overline{X}$	S.D	d.f	F	P	Scheffé Analysis
Mathematics literacy	Always	13	95.76	9.22	4–122	3.058	0.019	2–5
	Quite often	21	92.14	11.69				
	Occasionally	65	87.93	9.50				
	Rarely	22	85.63	8.46				
	Never	6	87.50	7.94				
Information literacy	Always	13	127.76	22.96	4–122	1.333	0.261	
	Quite often	21	130.19	21.93				
	Occasionally	65	129.01	19.95				
	Rarely	22	120.95	18.49				
	Never	6	114.66	18.75				

The findings suggest that there is a significant difference among pre-service teachers' perceptions of mathematics literacy self-efficacy levels in accordance with their book reading frequencies/rates ($F=3.05$, $p=0.019<0.05$). Therefore — according to the results of a Scheffé test performed for the purpose of determining in which groups the differences in the mathematics-literacy levels of the pre-service teachers could be found — the difference was found to lie in the fact that the pre-service teachers who always read books had a higher mathematics literacy-level than those who rarely read books.

On the other hand, the fact that the significance level of the 'p' value (0.261), in terms of information literacy, was greater than 0.05 suggests that there is no significant relationship between perceptions of self-efficacy in information literacy and the book-reading frequency/rate.

Table 8. The relation between the mathematics and information literacy self-efficacy levels

Dimension	N	Correlation	p
Mathematics and information literacy self-efficacy levels	127	0.267**	0.002

A significant relationship, at a low level but in a positive direction, was found between the self-efficacy perceptions of the pre-service teachers as to mathematics literacy and information literacy, in accordance with the 'r' score range ($r=0.267$, $p=0.002<0.01$). In this sense, it can be stated that the information-literacy levels of the pre-service teachers increase with an increase in their self-efficacy perceptions regarding mathematics literacy.

Results

A positive relationship was determined between the mathematics and information literacy self-efficacy levels of the pre-service teachers. When the literature was reviewed, there were a number of studies found that associated information literacy with other types of literacy. In the studies conducted with respect to information literacy — by Curzon (1995); Spitzer, Eisenberg and Lowe (1998) and Jager and Nassimbeni (2002) — it was defined as being a broad spectrum involving different types of literacy. In line with these definitions, it was concluded that there was a need to apply information-literacy skills in an accurate way, so as to enable the possession of advanced skills in all types of literacy. From this perspective, the fact that there is a positive correlation between mathematics literacy and information literacy is an expected outcome. In addition, since there is a positive correlation, it follows that increasing the information-literacy level, which is pre-requisite for all literacies, means increasing the level of mathematics literacy, as well. For this reason, the mathematics-literacy level can be maximized within the information-literacy curricula organized in universities by enabling librarians, academics, experts of information technologies and administrators to work collaboratively in this subject. According to the research findings, the perceptions of the pre-service teachers regarding their information literacy self-efficacy levels are average according to the scale's score rating; therefore, practices for the purpose of increasing those levels can be devised.

The experimental study performed by Kurbanoğlu and Akkoyunlu (2006) with respect to the information-literacy levels of sixth-grade secondary-school students found that there was a significant difference between the information-literacy levels of the students in the control group and those in the experimental group, as a result of education and training in information literacy. According to this study, it can be appropriate to provide education and training on information literacy, both for students and for teachers, with the help of librarians who graduated from a department of library science, experts in information technologies or academics. These educational programmes can be supported by activities involving the subjects, such as topic selection, setting an objective, tools for accessing information, library catalogues, searching techniques using a computer, writing sections of a report and the preparation of resources. As a result of this training, the individuals are expected to develop their capacities, such as using Boolean operators and apostrophes; performing language restrictions; being careful about such characteristics as

chronological-statistical resources, etc.; using Internet tools and search engines efficiently and being able to analyse written resources.

While the perceptions of the pre-service teachers' information literacy self-efficacy levels were seen to have not differed according to their class levels, their perceptions of mathematics literacy self-efficacy levels did, which agrees partially with the view of Bandura (1977). Bandura thought that an individual's belief in their self-efficacy increased with the passage of time and gaining of experience. In this study, self-efficacy perceptions regarding mathematics literacy increases with the class level, because the pre-service teachers came across different fields or practices of mathematics at each class level. On the other hand, the fact that fields unique to information literacy are not included in the course programme can be given as the reason that self-efficacy perception levels regarding this form of literacy failed to exhibit significant progress in this matter.

In this study, the perceptions of mathematics literacy self-efficacy levels were highest in those pre-service teachers who stated that they always read books. It can be said that there is a significant correlation between a person's book-reading frequency/rate and their mathematical literacy, because reading a book (whatever the subject) is an activity that develops an individual's thinking skills to a high level. This allows them to establish relationships among phenomena, as well as to operate mental processes associated with mathematics, such as performing analysis, speculation or generalization.

Library use and book-reading activities or events within the university curricula can be organized in order to eliminate the book-reading inefficacies of the pre-service teachers who will be the architects of future society. Studies finding ways to boost their interest in reading activities can also be conducted.

According to the research findings, it was concluded that the pre-service teachers' perceptions of their information literacy self-efficacy levels varied according to their access to the Internet or computers. There are a number of studies confirming this result as regards the relationship between computer usage and information literacy. As stated by Shapiro and Hughes (1996), information literacy is a process that also involves computer usage. For this reason, information literacy cannot be considered separate from computer usage.

Consequently, as the factors influencing the information and mathematics literacy levels of the pre-service teachers were determined regarding their access to the Internet or computers and book-reading frequencies/rates, library and computer literacy lessons should be added to the curriculum of the universities with regard to the teaching of Primary Mathematics Teachers. In addition to the results obtained, according to the independent variables examined, further descriptive and experimental studies can be conducted on broader research populations at different scales so as to acquire more varied and detailed information.

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