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# Distance education students' self-efficacy levels of mathematical literacy

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**It is of great concern that individuals can use mathematics as a tool today, when distance education is being adopted in several fields. The concept of mathematical literacy has also come to the fore due to the use of mathematical efficacy at various grade levels. Therefore, this research aims to investigate distance education students' self-efficacy levels of mathematical literacy. Survey model was used in this research. The sampling of the research consists of distance education students enrolled in a state university. Data collection tools were a Math Literacy Self-Efficacy scale and a personal information form. The SPSS16.0 statistical package was used for the statistical analyses of the research data. According to the results of the findings, distance education students' self-efficacy levels of math literacy were evaluated in terms of their success in mathematics, gender, views on quantitative courses, Internet use while studying mathematics and e-book reading about mathematics. The findings were discussed in the light of the relevant literature and some suggestions were presented for further research and researchers.**

**Key words:** Distance education, distance education students, mathematics, mathematical literacy, self-efficacy.

## INTRODUCTION

Distance education is being increasingly adopted by today's educational system at a global level. As is known, distance education is a way of delivering instruction from a specific center via various media and specially designed instruction units to students, when it is impossible to carry out in-class activities due to the lack of traditional learning-teaching methods (Kaya et. al., 2004). Distance education, which provides an opportunity for individualized instruction independent of time and place, is today's most modern way of education made possible via communication technologies and particularly the Internet (Baturay and Bay, 2009).

Scientific literacy is defined as an individual's knowledge and abilities necessary to perform cognitive processes and make decisions in cases that require scientific and technological understanding (Laugksch, 2000). In today's world, where technological advance is occurring at an ever-faster pace, scientific literacy is defined as the ability of efficient use of communicative symbols whose meanings are attached by the society by Kellner (2001) as suggested by Kurudayıoğlu and Tüzel (2010). The concept of literacy means an individual's ability to find, use, adopt and evaluate written sources in order to improve his knowledge and potentials and participate in the society more effectively (Küçük and Demir, 2009; Akyüz and Pala, 2010). On the other hand, today it is essential for individuals to improve both their skills of reading printed (traditional) texts and visual and electronic texts (Kurudayıoğlu and Tüzel, 2010).

Literacy requires individuals to become aware of not only reading and writing habits but also mathematical and logical functions (NRC, 1989). In this context, the concept

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of mathematical literacy, which is based on applications and modelling, has come to the fore as a social need due to the gradual impact of mathematics and technology (Uysal, 2009). As suggested by Uysal and Yenilmez (2001), mathematical literacy is an individual's capacity of mathematical functions, which indicates the individual's abilities at cultural and social levels and this capacity contains various facts, abilities, processes and fundamental applications in daily and business life (Edge, 2003). According to OECD (2006), mathematical literacy is "an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen." Therefore, it can be concluded that mathematical literacy equips the individual with an awareness of the role that mathematics plays in the modern world, an ability of quantitative and spatial reasoning and critical analysis and problem solving in daily life (Özgen and Bindak, 2008). It is a fact that individuals need to confide in their own skills to become a math literate, use mathematics, support and show their quantitative ideas (Özgen and Bindak, 2008). Therefore, what really matters is math literacy self-efficacy belief, which is defined as an individual's judgement of or beliefs in his own abilities to deal with mathematical processes, skills and situations. Self-efficacy is defined as "the belief in one's capabilities to organize and execute the sources of action required to manage prospective situations" by Bandura (1986). Individuals with high self-efficacy expectation are known to make more efforts in approaching difficult tasks and activities (Pajares and Kranzler, 1995) and they are more persistent in the face of challanges (Schunk, 1989). "Students need to develop confidence in their abilities to reason and justify their mathematical thinking" (WNCP, 2006). Therefore, self-efficacy, which is the individual's judgement or belief concerning himself, plays an important role in building mathematical literacy (Özgen and Bindak, 2011).

On the other hand, learning is more individualistic and independent in distance education, where learning environment requires more personal effort; and hence, intrinsic motivation is necessary to ensure effective learning (Kaya, 2002). Students with high levels of self-efficacy expectation approach learning activities more willingly make greater efforts over a longer period of time and use more effective strategies when confronted with difficulties, which make them exhibit a higher level of performance than the students with low levels of self-efficacy expectation (Eggen and Kauchak, 1999 cited in Ergül, 2006). Consequently, their math literacy self-efficacy is of great concern in the learning process of distance education students. As is known, individuals with high self-efficacy expectation tend to be less worried about their performance and perform better academically (Pajares and Miller, 1994; Pajares, 1996).

As suggested by Özgen and Bindak (2011), self-efficacy belief about math literacy is the belief and judgment in one's own capabilities when faced with mathematical challenges in school, work, and daily lives. Zimmerman (2000) states that self-efficacy is multidimensional in nature and need to be measured in a way that is sensitive to variations in performance context. Therefore, it can be concluded that distance education students' math literacy self-efficacy beliefs should be investigated in terms of not only mathematical success but also other variables.

As suggested by Özgen and Bindak (2011), self-efficacy belief, which is also defined as an individual's self-judgement of his mathematical capabilities, has been analysed by many researchers with different age groups and in various contexts in the field of mathematics education. However, it is observed that there are not many researches into students' self-efficacy beliefs of math literacy. Besides, there is no research into distance education students' math literacy in the literature. In the light of these data, this research was planned to investigate distance education students' self-efficacy levels of math literacy. In today's information society, where distance education is of great concern, this research is expected to contribute not only to distance education students but also the literature about math literacy and distance education.

## Aim of the research

This research aims to investigate distance education students' self-efficacy levels of mathematical literacy. In line with this aim, students' mathematical literacy has been evaluated in terms of their success in mathematics, gender, views on quantitative courses, Internet use while studying mathematics, parents' educational background and e-book reading about mathematics.

## Sub-problems

Do distant education students' self-efficacy levels of mathematical literacy differ in terms of:

1. Gender
2. Internet use while studying mathematics
3. E-book reading about mathematics
4. Their views on studying quantitative courses
5. Parents' educational background
6. Success in mathematics

## METHOD

This section presents information pertaining to study sampling, data

**Table 1.** Results of the independent group t test conducted to determine whether math literacy self-efficacy scores differ or not in terms of gender.

| Scores | Groups | N | X | SS | $SH_x$ | t test | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | t | Sd | p |
| Self-efficacy | Female | 50 | 83.420 | 0.402 | 0.056 | -1.452 | 60.393 | .152 |
| | Male | 38 | 87.578 | 0.612 | 0.099 | | | |

**Table 2.** Results of the independent group t test conducted to determine whether math literacy self-efficacy scores differ or not in terms of internet use.

| Score | Group | N | X | SS | $SH_x$ | t test | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | t | Sd | p |
| Self-efficacy | Yes | 54 | 86.092 | 0.420 | 0.057 | 747 | 51.820 | .459 |
| | No | 34 | 83.823 | 0.625 | 0.107 | | | |

collection and data analysis of the research, which was carried out in survey method. The research is in descriptive-survey model. Survey model aims at describing a situation in the past, or in the present, as it was and as it is (Karasar, 2005).

### Population and sample

The research population is limited to distance education students enrolled in İstanbul University. The research sample consists of 88 randomly chosen distance education students enrolled at the department of Computer Education and Instructional Technology in Istanbul University during 2012 to 2013 academic year and having taken the course of mathematics. In statistical analyses, the significance level was taken as .05.

### Data collection

During the collection of the data, the Math Literacy Self-Efficacy Scale developed by Özgen and Bindak (2008) was used in order to determine self-efficacy levels of math literacy. The five-point Likert type scale consisted of 25 items. The inner consistency coefficient (Cronbach's Alpha) of the scale, which had been tested for validity and reliability, was calculated as 0.94. The inner consistency coefficient (Cronbach's Alpha) was calculated as 0.90 for this study. The demographical data were collected using a demographical information form developed by the researcher.

### Data analysis

In accordance with the overall aim of the research, SPSS19.0 package programme is used for the necessary statistical deciphering of the collected data related to the problems this study deals with (Büyüköztürk, 2003). The responses given to the scale items were scored as follows: I totally agree = 5, I agree = 4, I am not sure = 3, I disagree = 2, I totally disagree = 1. Total scale score was calculated for each student. The lowest possible score was 25 while the highest possible score was 125. It can be concluded that students with high total scale scores had high self efficacy levels of math literacy. Independent group t-test, Mann Whitney-U test and Kruskal Wallis test were used for the analyses of the data.

## FINDINGS

This section presents the findings and interpretations pertaining to the research sub-problems in accordance with the aim of the research.

As shown in Table 1, as a result of the independent group t-test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not in terms of gender, the difference between the groups' arithmetic means was not found to be statistically significant. Accordingly, it can be concluded that distance education students' math literacy self-efficacy scores did not differ in terms of gender. However, when Table 1 was examined, it was observed that female students' scores (83,420) were lower than male students' scores (87,578).

As shown in Table 2, as a result of the independent group t-test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not in terms of Internet use, the difference between the groups' arithmetic means was not found to be statistically significant. Accordingly, it can be concluded that math literacy self-efficacy scores of the students in the research sample did not differ in terms of Internet use while studying mathematics. Although there was not a statistical difference, the students who use the Internet had higher math literacy self-efficacy scores (86,092) than those who do not (83,823).

As shown in Table 3, as a result of the non-parametrical Mann Whitney-U test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not in terms of e-book reading about mathematics, the scores of those who read e-books were found to be higher than those who do not. According to this finding, it can be concluded that e-book reading about mathematics had a positive effect on math literacy self-efficacy scores of the students in the research sample.

**Table 3.** Results of the non-parametrical Mann Whitney-u test conducted to test the meaningfulness of the difference between math literacy self-efficacy scores in terms of e-book reading about mathematics.

| Gender | N | S.T. | S.O. | U | z | |
|---|---|---|---|---|---|---|
| Yes | 20 | 56.20 | 1124.00 | | | |
| No | 68 | 41.06 | 2792.00 | 446.00 | -2.332 | .020 |
| Total | 129 | | | | | |

**Table 4.** Results of the Kruskal Wallis test conducted to determine whether math literacy self-efficacy scores differ or not in terms of views on quantitative courses.

| Score | Group | N | Mean rank | Chi-square | Sd | p |
|---|---|---|---|---|---|---|
| Self-efficacy | I can only study efficiently from a computer screen | 4 | 52.00 | 1.705 | 2 | 0.426 |
| | I can only study efficiently with paper and pencil | 36 | 40.42 | | | |
| | I can study efficiently using both | 48 | 46.94 | | | |
| | Total | 88 | | | | |

**Table 5.** Results of the Kruskal Wallis test conducted to determine whether math literacy self-efficacy scores differ or not in terms of mother's education.

| Score | Group | N | Mean rank | Chi-square | Sd | p |
|---|---|---|---|---|---|---|
| Self-Efficacy | Never schooled | 10 | 41.90 | 3.376 | 4 | 0.497 |
| | Primary school graduate | 44 | 42.89 | | | |
| | Secondary school graduate | 12 | 51.33 | | | |
| | High school graduate | 12 | 52.58 | | | |
| | University graduate | 10 | 36.30 | | | |
| | Total | 88 | | | | |

As shown in Table 4, as a result of the Kruskal Wallis test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not in terms of views on quantitative courses, the difference between the groups' arithmetic means was not found to be statistically significant. Accordingly, it can be concluded that students' math literacy self-efficacy scores did not differ in terms of their views on studying quantitative courses. On the other hand, it was observed that the students (4) who state they can only study efficiently from a computer screen had higher math literacy levels. The number of students who state they study efficiently using both the computer and paper and pencil (48) was higher than those who study quantitative courses using paper&pencil only (36). In addition, the students who state they study efficiently using both methods had higher math literacy self-efficacy scores than those who use paper and pencil only.

As shown in Table 5, as a result of the Kruskal Wallis test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not, the difference between the groups' arithmetic means was not found to be statistically significant. Accordingly, it can be concluded that math literacy self-efficacy levels of the students in the research sample did not differ in terms of mother's level of education. On the other hand, although there was not a statistical difference, it was observed that the children whose mothers were never schooled had the lowest arithmetic means.

As shown in Table 6, as a result of the Kruskal Wallis test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not in terms of father's education, the difference between the groups' arithmetic means was not found to be statistically significant. According to this finding, it can be concluded that math literacy self-efficacy levels of the students in the research sample did not differ in terms of father's level of education. However, when Table 6 was examined, it was observed that math literacy self-efficacy levels of the students whose fathers were never schooled were the lowest.

As shown in Table 7, as a result of the Kruskal Wallis test conducted to determine whether students' math literacy self-efficacy scores differ significantly or not in

**Table 6.** Results of the Kruskal Wallis test conducted to determine whether math literacy self-efficacy scores differ or not in terms of father's education.

| Score | Group | N | Mean rank | Chi-square | Sd | p |
|---|---|---|---|---|---|---|
| Self-efficacy | Never Schooled | 4 | 19.50 | 4.682 | 4 | 0.322 |
| | Primary school graduate | 38 | 43.37 | | | |
| | Secondary school graduate | 16 | 47.06 | | | |
| | High school graduate | 18 | 48.94 | | | |
| | University graduate | 12 | 46.33 | | | |
| | Total | 88 | | | | |

**Table 7.** Results of the Kruskal Wallis test conducted to determine whether math literacy self-efficacy scores differ or not in terms of mathematics midterm scores.

| Score | Group | N | Mean rank | Chi-square | Sd | p |
|---|---|---|---|---|---|---|
| Self-efficacy | Scores 0-49 | 14 | 30.21 | 8.083 | 4 | 0.089 |
| | Scores 50-59 | 10 | 48.00 | | | |
| | Scores 60-72 | 12 | 40.58 | | | |
| | Scores 73-87 | 22 | 54.27 | | | |
| | Scores 88-100 | 30 | 44.40 | | | |
| | Total | 88 | | | | |

terms of mathematic midterm scores, the difference between the groups' arithmetic means was not found to be statistically significant. Accordingly, it can be concluded that students' math literacy self-efficacy levels did not differ in terms of mathematics achievement grades. However, although there was not a statistical difference, it was observed that the students whose grades were lower than 50 had lower math literacy self-efficacy scores.

When students' math literacy self-efficacy levels were analysed, the highest score was found to be 116 and the lowest score was found to be 51. Besides, female students' mean score was 83,420 while male students' was 87,578. It can be concluded that they have a high level of math literacy.

## DISCUSSION AND CONCLUSION

According to the research results, it was determined that self-efficacy levels of math literacy did not differ significantly in terms of gender, academic achievement, views on quantitative courses, Internet use while studying mathematics and parents' educational background. Besides, math literacy self-efficacy levels of those who read e-books about mathematics were found to be higher than those who do not. In addition to this, distance education students' self-efficacy levels of math literacy were considered to be high.

According to the finding of the first research sub-problem, it was observed that distance education students' self-efficacy beliefs of math literacy did not differ in terms of gender. Since there is no research with a similar sampling, further research is necessary to support this finding. When Table 1 is analysed so as to evaluate the findings, it is seen that there is no statistical difference; however, male students' math literacy scores were found to be a little higher than those of female students. Therefore, it can be concluded that math literacy level did not differ in terms of gender; however, male students exhibited a higher level of math literacy. The researches into math literacy also suggest that self-efficacy beliefs did not differ in terms of gender whereas there are some researches which suggest that male students' self-efficacy levels were higher than those of females (Soytürk, 2011; Uysal and Yenilmez, 2011; Özgen and Bindak, 2011; Akaya and Memnun, 2012; Yenilmez and Turgut, 2012). According to these data, it can be concluded that students' math literacy did not differ in terms of gender.

Although there was not a significant statistical difference, it was observed that those with grades lower than 50 had lower math self-efficacy scores than the rest. Instructor and student are not in a classroom situation in distance education; however, the quality of the relationship, which is ensured by means of communication technologies, also plays a role in success with several other factors and individualistic differences top these factors (Höçük, 2011). According to the results of the research conducted by Ergül (2004) with distance education students, it was observed that students'

academic achievement was not linked with their self-efficacy levels. Besides, when Table 7 is analysed, it is seen that the students with academic achievement scores of 73 to 87 had a higher level of math literacy when compared to the others. Their math literacy level was even higher than those with scores of 88 to 100. However, when the fact that these researches are not into distance education students' self-efficacy beliefs of math literacy is considered, it can be concluded that further research is necessary to support these findings.

On the other hand, although there was no significant statistical difference, children whose parents were never schooled had a lower mean than the others. According to the research, it is observed that the more educated are the parents, the higher is the level of math literacy (Uysal, 2009; Uysal and Yenilmez, 2011; Özgen and Bindak, 2011; Soytürk, 2011). Although they are not conducted with distance education students, the findings of these researches seem to support the findings of this research. Besides, parents' socio-economic status play a key role in shaping students' mathematics self-efficacy (O'Brien et al., 1999; Schulz, 2005). When parental level of education and parents' contribution to students are taken into account, parents' socio-economic status is considered as a significant variable in interpreting students' math literacy self-efficacy beliefs, which is also suggested by Özgen and Bindak (2011).

Although there was not a significant statistical difference, students who use the Internet regularly had higher math literacy scores. On the other hand, when their views on quantitative courses are analysed, students who claimed they only learn efficiently from a computer screen had a higher level of math literacy. Another important research finding is that students who read e-books about mathematics had higher self efficacy levels of math literacy than those who do not. Consequently, this finding can be said to be expected since the fact that instruction is delivered via the Internet and course notes are stored in e-books in distance education. Individuals with higher self-efficacy beliefs are willing to learn by themselves. Therefore, they can be said to read not only mathematics course books but also other documents in e-book format.

The following suggestions are presented for further research and researchers in the light of the data presented in this research:

- More quantitative and qualitative research can be done into math literacy self-efficacy beliefs of distance education students who study mathematics as part of the curriculum.
- Instructors can identify math literacy self-efficacy levels at the beginning of the semester and students can be instructed accordingly during the semester.
- The role of Internet use and e-book reading in shaping math literacy self-efficacy beliefs can be studied quailtatively and with a more extensive sample.
- Further research can be conducted in order to investigate and compare distance education students' math literacy and other literacy.

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