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*Full Length Research Paper*

# The determination of visually impaired students' multiple intelligences dimensions and their relationships with success in mathematics

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**The purpose of this study was to investigate visually impaired students' multiple intelligences dimensions and their relationship among gender, sight level and math achievement. In this study "multiple intelligences inventory" was used as data gathering instrument. The study was carried out with 65 visually impaired students studying in sixth, seventh and eighth classes in "visually impaired" schools in Denizli, Erzurum and Gaziantep in the second term of 2007 to 2008 academic year. As a result, it was found that visually impaired students were mostly good at interpersonal intelligence, whereas bad at on visual-spatial intelligence. The study results have also shown that there was a significant relationship between the math achievement of visually impaired students with logical-mathematical intelligence, intrapersonal intelligence, spatial intelligence and linguistic intelligence dimensions.**

**Key words:** Multiple intelligence theory, math achievement, visually impaired students.

## INTRODUCTION

Being visually impaired is defined as "loss of sight that affects a student's educational achievement in a negative way and which cannot be recovered" (Özer, 2001). There are some criteria that differentiate blindness from not seeing well. After all required recoveries are done, the person whose seeing eye has sight level of at most one tenth of normal eye and whose eyesight angle cannot exceed twenty degree is called as "blind" (Demir and Şen, 2009: 35). Education begins with recognition of who is educated. The beginning of education for these individuals who we try to make gain the required behaviors, although not knowing any of their physical, emotional, social and other characteristics, results in unnecessary usage of time and materials, which harms them (Büyükkaragöz et al., 1998). In learning with concrete experience, understanding of experience and problem solving are important instead of reaching generalization. In this phase, feeling of position is more important than thinking on the subject. In visually impaired students' education and training, Braille writing system based on six points is used. Six points are placed vertically in two columns and horizontally in three rows. The points in this system were numbered as follows: Starting from the first point to last point (from top to bottom) of first column, the points are numbered as first, second and third points respectively. In the second column, the points are numbered from top to bottom as fourth, fifth and sixth points, respectively. There is a fixed and equal distance between any two points in this set of six points. All symbols in the alphabet are derived from this system based on such numbering system.

### Numbering

1↔• •↔4

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2↔• •↔5
3↔• •↔6

The Braille writing system is developed according to French alphabet. However, countries with different language structure and alphabet developed their own Braille writing alphabet and used it with the help of same principal (www.okulweb.meb.gov.tr, 2011). In the literature, there are studies related to visually impaired students' learning styles (Demir and Şen, 2009), various teaching methods' effects on visually impaired students' achievements (Bayram, 2006; Karakoç, 2002; Şafak, 2007; Tuncer, 1994; Tuncer and Kahveci, 2009) and degree of realization of course programs' aims by visually impaired students (İnce, 1996; Akkuş, 2006). Demir and Şen (2006) determined that the majority of visually impaired students had "decomposition" learning style according to Kolb learning model and especially male students' learning styles showed more variation. In addition, there was a significant difference between learning styles and gender, mother's education status, father's education status. On the other hand, it was found that there was not a significant difference between sight levels (blind or less sight) and learning styles. Şafak (2007) stated that adapted digits teaching method is effective in realizing goals in addition with carry of two digits and one digit numbers. Tuncer (1994) found that individualized teaching material through adapted digits teaching method is more effective in value of digits and addition with carry than traditional method. Karakoç (2002) stated that direct instruction materials presented to students through peers were effective in students' verbal problem solving achievements (As Cited in Tuncer and Kahveci, 2009). Bayram (2006) emphasized that: "usage of direct instruction in verbal problem solving teaching by observing themselves" was effective in problem solving performance of students seeing less. Tuncer and Kahveci (2009) study indicated that skill for usage of concept map through peers for summarizing was effective in understanding and remembering what visually impaired students read during instruction. In addition to this, it was found that participants could generalize their skills to new texts. Akkuş (2006) found that normal students were more successful in mathematics test than visually impaired students. Blind students, with respect to students seeing less, were more successful in mathematics criterion subject to goals in the measurement tool. That is to say, blind students were found to be more successful in mathematics test than students' seeing less. Each individual has their own characteristics. Teachers should consider their students' individual differences and prepare teaching-learning environments appropriate to these differences (Ülgen, 1995). There are many views about how to apply appropriately individual differences in the process. During many years, various searches, different teaching strategies, methods and techniques have been developed. At this point, "multiple intelligence theory" is on the front in recent years due to the fact that it considers individual differences, focusing and improving on individual's potentials (Akamca and Hamurcu, 2005).

Gardner (2004) defended that intelligence could not be explained just by one factor, instead it covers many skills in spite of the traditional approach defending the objective measurement of human intelligence. Gardner defined intelligence as the capacity of value of producing an output in one or more cultures, finding effective and productive solutions to problems in their real lives and discovering new or mixed problems which should be solved. "Multiple intelligence theory" was a product of "project zero" project of Gardner in Harvard University based on normal and gifted students' cognitive potentials of development process and intelligence disorder based on damages of brain. Specifically, studies on intelligence disorder based on brain damages were pathfinder. Difficulties of individuals due to different brain region damages were seen to be supported and solved by other regions of brain (Demirel et al., 2006). In Gardner's "frames of mind" published in 1983, he defended that human beings has a range of skills under at least seven types of intelligence dimensions. Although Gardner stated seven types of intelligence, he also added that these are not enough to express skills of human and there might be other intelligences as well. Thus, in Checkley interview with Gardner, Gardner mentioned eight type of intelligence, in 1999 he published "intelligences reframed" book and he reframed multiple intelligence theory by covering this eighth types of intelligence. According to Gardner, these eight types of intelligence are the following: verbal-linguistic intelligence, logical-mathematical intelligence, visual-spatial intelligence, musical-rhythmic intelligence, bodily-kinesthetic intelligence, interpersonal intelligence, intrapersonal intelligence and naturalistic intelligence (Saban, 2004).

**Verbal-linguistic intelligence**

People use language for convincing others to an action, remembrance of rules of a game, description of an address, usage of a machine and other various ways, realization of teaching and learning (Gardner, 2004). Verbal-linguistic intelligence is an effective usage of concepts in a storyteller, speaker or as a politician in a verbal way, or effective usage of language in written form as a writer, editor or journalist. This intelligence necessitates usage of their own language with appropriate grammar, word and pronunciation, and concepts with appropriate meanings (Armstrong, 1994).

**Logical-mathematical intelligence**

Logical-mathematical intelligence is a skill about thinking with numbers, calculation, deriving conclusions,

constituting logical relationships, problem solving, critical thinking, introducing with abstract symbols like numbers, geometrical shapes, relating knowledge pieces (Onay, 2006). This intelligence could be used in classification of objects, quantification of objects based on some characteristics, calculation, making generalization, testing hypothesis (Armstrong, 1994).

### Visual-spatial intelligence

It is a skill about thinking with paintings, images, figures and lines, perceiving and reasoning in three dimensional things (Onay, 2006). This intelligence covers sensibility towards colors, lines, figures and the relationship between them. Besides, it covers skills about visualization of ideas, thoughts, transforming into graphics (Armstrong, 1994). The focus of this intelligence is based on perceiving visual world in a right way, doing changes on perceptions at the beginning and transformation, reproducing visual experience in the absence of physical object (Gardner, 2004). When this intelligence is supported with naturalistic, mathematical and verbal intelligences, human beings could move to other planets, stars, galaxies and to constitute new living environments there (San, 2004).

### Musical-rhythmic intelligence

The studies on people who had damages on their brains indicated that musical perception has a special location. In experiments on normal humans, it is found that musical skills are collected in the right hemisphere (Gardner, 2004).

### Bodily-kinesthetic intelligence

This intelligence is about the usage of body in different forms to express and achieve a goal. Characteristics of this intelligence are picturing objects with hands and fingers and realizing the whole body with movements (Gardner, 2004).

### Interpersonal intelligence

It is a skill about cooperative learning, communication with and without words, understanding, sharing, stating, interpreting feelings, thoughts and behaviors, and convincing (Onay, 2006). This intelligence also covers sensibility towards gestures, sound, mimics; noticing different characteristics between humans, giving effective and appropriate answer skills (Armstrong, 1994).

### Intrapersonal intelligence

Intrapersonal intelligence is a skill about recognition of individuals' own feelings, reaction level of feelings, thinking process, evaluating themselves and constituting their own goals (Onay, 2006). This intelligence also covers understanding self, trusting to own and self-control skill (Armstrong, 1994).

### Naturalistic intelligence

This is a skill about recognition of all living things, searching and thinking about creation of these living things (Onay, 2006). This intelligence is named as naturalistic, environment and living things intelligence (San, 2004). According to Lazeara, this intelligence covers both artificial and natural environment. Scouts', mountaineers', biologists' and zoologists' naturalistic intelligence are more developed (Bümen, 2004). In the focus of Gardner's naturalistic intelligence, categorization of outstanding differences and similarities between objects is covered as a skill (Uzoğlu, 2006). When the literature is examined, it is easy to coincide studies about multiple intelligence theory. There are studies like the reflections of multiple intelligence theory on education (Talu, 1999); the effect of teaching appropriate to multiple intelligence theory on students' success (Akamca and Hamurcu, 2005; Aydoğan, 2006; Gürçay and Eryilmaz, 2002; Köroğlu and Yeşildere, 2004; Kuloğlu, 2005; Şengül and Saydam, 2004), students' intelligence dimensions and its relationship with students' gender (Loori, 2005; Rammstedt and Rammsayer, 2000; Uzoğlu, 2006). However, there is no study about visually impaired students' intelligence dimensions and their relationship with students' mathematics achievements.

### Research problem

The research problem is to determine the visually impaired students' intelligence dimensions in second level of elementary education, to investigate the effects of sight level and gender on these students' intelligence dimensions, and to introduce the relationship between these students' mathematics achievements and their intelligence dimensions.

## METHODS

### Sample

Population of the study is composed of visually impaired students in second level elementary schools in Turkey during 2007 to 2008 academic year, and sample is composed of 65 students, 29 female and 36 male visually impaired students in second level elementary schools in Denizli, Erzurum and Gaziantep Provinces. 30 students were blind and 35 students were seeing less. This study was conducted during spring semester of 2007 to 2008 academic year in second levels of Denizli Visually Impaired Students Elementary School, Erzurum Visually Impaired Students Elementary School and Gaziantep Gap Visually Impaired Students Elementary School.

**Table 1.** Items in the questionnaire based on multiple intelligence dimensions.

| Intelligence dimensions | Items in the questionnaire |
|---|---|
| Verbal-linguistic intelligence | 1, 5, 10, 11, 37, 43, 48, 63, 68, 70. |
| Logical-mathematical intelligence | 9, 18, 24, 26, 27, 28, 45, 46, 47, 57. |
| Visual-spatial intelligence | 7, 12, 15, 17, 21, 23, 34, 54, 56, 69. |
| Musical-rhythmic intelligence | 6, 14, 29, 49, 50, 51, 52, 58, 59, 62. |
| Bodily-kinesthetic intelligence | 4, 8, 13, 16, 19, 30, 38, 44, 53, 66. |
| Intrapersonal intelligence | 20, 22, 25, 31, 39, 40, 42, 55, 65, 67. |
| Interpersonal intelligence | 2, 3, 32, 33, 35, 36, 41, 60, 61, 64. |

**Table 2.** Mean scores of visually impaired students under each intelligence dimension.

| Intelligence Dimensions | Mean | Standard deviation |
|---|---|---|
| Verbal-linguistic intelligence | 1.226 | 0.429 |
| Logical-mathematical intelligence | 1.496 | 0.379 |
| Visual-spatial intelligence | 1.005 | 0.518 |
| Musical-rhythmic intelligence | 1.509 | 0.426 |
| Bodily-kinesthetic intelligence | 1.360 | 0.328 |
| Interpersonal intelligence | 1.517 | 0.278 |
| Intrapersonal intelligence | 1.340 | 0.364 |

#### Instruments

Data were gathered through Uzoğlu (2006) “multiple intelligence test”. This questionnaire was developed by Sue Tele and Anne Biro, it was transcribed to Turkish language by Gürçay, Eryilmaz, Uysal and experts. Multiple intelligence test was composed of 70 items. For determining the students’ intelligence dimensions, there were 10 items about each intelligence dimension. Items about each intelligence dimension were distributed in the questionnaire in a mixed way. Validity and reliability of the questionnaire were determined by Gürçay and Eryilmaz (2002). Cronbach Alfa coefficient was found as 0.86. Participant students filled the questionnaire through controlling each item and with respect to their answers their intelligence dimensions were determined. Items about the intelligence dimensions are presented in Table 1. Visually impaired students’ mathematics achievement was based on report cards of autumn term of 2007 to 2008 academic year. In the questionnaire there is no item under naturalistic intelligence, so there is no finding regarding this intelligence dimension.

#### Implementation of questionnaire

Before the application of questionnaire, students were told that this was not an exam, their results would not be shared with others and there was no time limitation for them. For blind students, the researcher read each item for the student and coded. A questionnaire with big fonts was prepared for students seeing less. Besides, when the students did not understand the items in the questionnaire, necessary explanations were done.

## Data analysis

Items in the questionnaire were coded as yes (2), no idea (1), and no (0). Findings were evaluated through SPSS 13.0 program. T test and Pearson correlation test were applied to the data gathered and through realizing statistical analysis, findings were presented. Besides, descriptive method was used in analysis of data.

## Findings

Mean of scores gathered from the questionnaire filled by visually impaired students are presented in Table 2. As seen in Table 2, visually impaired students specified themselves the strongest in interpersonal intelligence with 1,517 mean and musical-rhythmic intelligence with 1,509 mean. They stated that they are weakest in visual-spatial intelligence with 1,005 mean and verbal-linguistic intelligence with 1,226 mean. Based on these findings, there are significant differences in visually impaired students’ multiple intelligence dimensions. From the data in Table 1, visually impaired students’ average scores are low in visual-spatial intelligence and verbal-linguistic intelligence dimensions with respect to other intelligence dimensions. The distribution of visually impaired students’ intelligence that they feel strong and weak and logical-mathematical intelligence dimensions are presented with histograms in Figures 1 to 5. The effect on gender in multiple intelligence dimensions of visually impaired students were investigated and findings gathered are presented in Table 3. As seen in Tables 3 and 4, gender did not have a meaningful effect on visually impaired students’ multiple intelligence dimensions. The relationship between the sight level of visually impaired students and multiple intelligence dimensions were investigated. According to independent samples t test

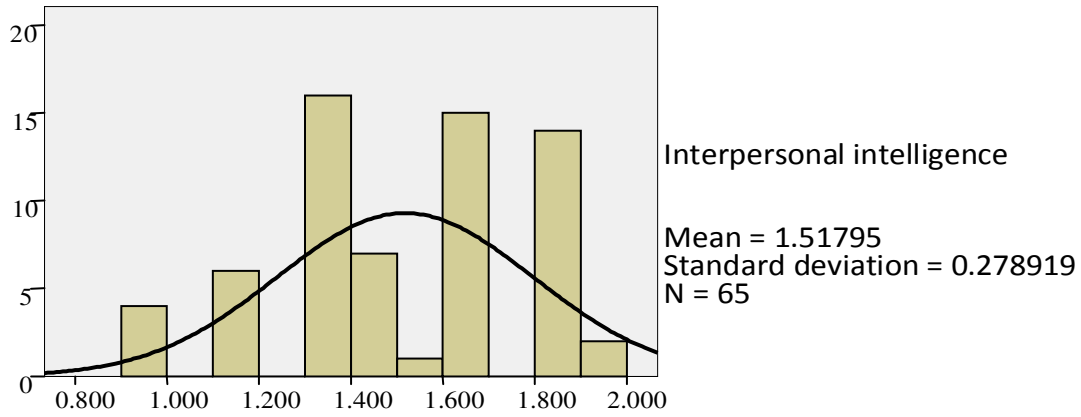


**Figure 1.** The distribution of visually impaired students' scores under interpersonal intelligence dimension.

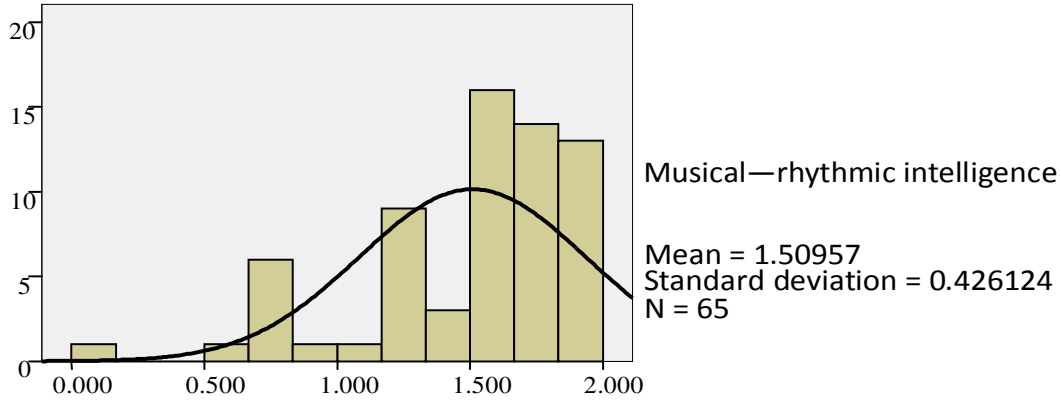


**Figure 2.** The distribution of visually impaired students' scores under musical-rhythmic intelligence dimension.

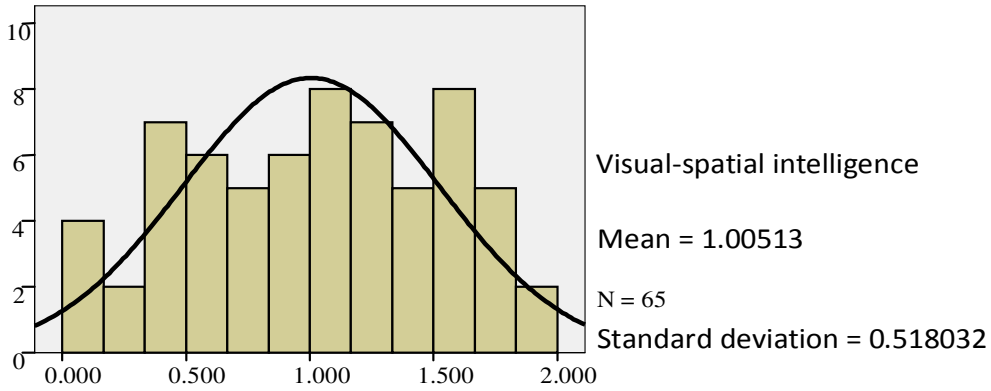


**Figure 3.** The distribution of visually impaired students' scores under visual-spatial intelligence dimension.

results, sight level did not have an effect on multiple intelligence dimensions except musical-rhythmic intelligence and visual-spatial intelligence dimensions. Blind students' musical-rhythmic intelligence dimension

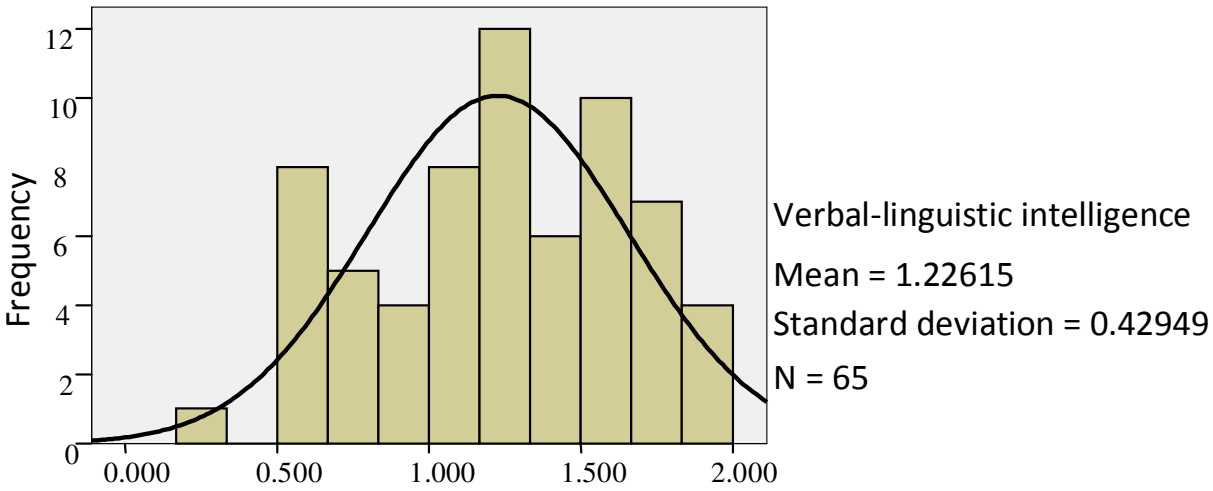


**Figure 4.** The distribution of visually impaired students' scores under verbal-linguistic intelligence dimension.

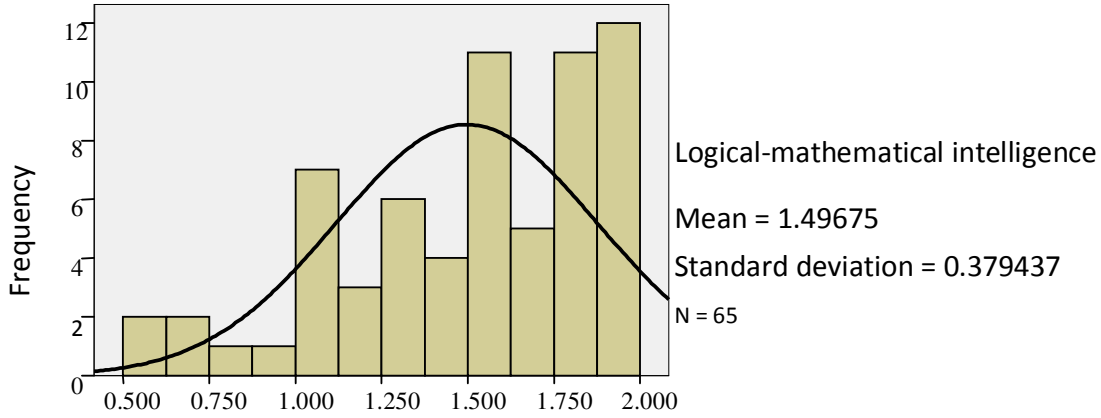


**Figure 5.** The distribution of visually impaired students' scores under logical-mathematical intelligence dimension.

was higher than students seeing less. There is a meaningful difference in favor of blind students ($p<0.05$). Under visual-spatial intelligence dimension, there is a meaningful difference in favor of students' seeing less ($p<0.05$). The relationship between multiple intelligence dimensions and sight level based on independent samples t test is presented in Table 4. Pearson correlation test was applied to investigate the relationship between visually impaired students' mathematics achievements and their multiple intelligence dimensions. The result of this test is presented in Table 5.

When Table 5 is analyzed, there is a meaningful relationship between visually impaired students' mathematics achievements and their logical-mathematical intelligence, intrapersonal intelligence, verbal-linguistic intelligence, and visual-spatial intelligence dimensions ($p<0.05$). Inspite of this, there is no meaningful relationship between these students' mathematics achievements and their musical-rhythmic intelligence, interpersonal intelligence and bodily-kinesthetic intelligence dimensions. The relationship between visually impaired students' mathematics achievements and multiple intelligence dimensions are presented in Table 5.

## DISCUSSION AND CONCLUSION

In this study, conclusions based on research findings are discussed. Besides, recommendations are presented from the window of research findings. Conclusions based on these findings were shown as follows: multiple intelligence dimensions of visually impaired students in second level elementary education were determined. As a result, the strongest multiple intelligence dimensions of these students were found as interpersonal intelligence

**Table 3.** Multiple intelligence dimensions based on gender (the result of independent samples t test about female and male students' scores in their intelligence dimensions).

| Intelligence dimensions | Gender | Number of students | Mean | Standard deviation | Independent samples t test | | |
|---|---|---|---|---|---|---|---|
| | | | | | t | df | p |
| Musical-rhythmic intelligence | Male | 36 | 1.48 | 0.41 | -0.60 | 63 | 0.54 |
| | Female | 29 | 1.54 | 0.44 | | | |
| Interpersonal intelligence | Male | 36 | 1.55 | 0.24 | 1.03 | 63 | 0.30 |
| | Female | 29 | 1.47 | 0.31 | | | |
| Visual-spatial intelligence | Male | 36 | 0.96 | 0.51 | -0.61 | 63 | 0.54 |
| | Female | 29 | 1.04 | 0.53 | | | |
| Verbal-linguistic intelligence | Male | 36 | 1.23 | 0.42 | 0.26 | 63 | 0.79 |
| | Female | 29 | 1.21 | 0.44 | | | |
| Logical-mathematical intelligence | Male | 36 | 1.52 | 0.41 | 0.60 | 63 | 0.55 |
| | Female | 29 | 1.46 | 0.33 | | | |
| Intrapersonal Intelligence | Male | 36 | 1.40 | 0.33 | 1.67 | 63 | 0.09 |
| | Female | 29 | 1.25 | 0.38 | | | |
| Bodily-kinesthetic intelligence | Male | 36 | 1.38 | 0.29 | 0.78 | 63 | 0.47 |
| | Female | 29 | 1.32 | 0.37 | | | |

and musical-rhythmic intelligence dimensions. The weakest multiple intelligence dimensions were visual-spatial intelligence and verbal-linguistic intelligence dimensions. Uzoğlu (2006) determined in his study as: "the strongest multiple intelligence dimension was found as logical-mathematical intelligence and the weakest one was found as visual-spatial intelligence." The weakest intelligence type found in this study was parallel to the finding in Uzoğlu (2006) study. It is confirmed that there is meaningful effect of level of second level of elementary school visually impaired students' sight on visual-spatial and musical-rhythmic intelligence dimensions. Accordingly, blind students were found as stronger than students seeing less in musical-rhythmic intelligence dimension, and students seeing less were stronger than blind ones under visual-spatial intelligence dimension. Gender did not have an effect on visually impaired students' multiple intelligence dimensions in second level of elementary school. This finding is parallel to Kuloğlu (2005) finding as: "there is no meaningful relationship between multiple intelligence dimensions and students' gender." Yet there are also studies in related literature approving this relationship. In Rammstedt and Rammsayer (2000) study, male students stated that they felt themselves strong in logical-mathematical intelligence and visual-spatial intelligence dimensions, and female students specified their strongest dimensions as musical-rhythmic intelligence and interpersonal intelligence dimensions. Loori (2005) determined that male students perceived themselves strong in logical-mathematical intelligence dimension and female students perceived themselves strong in intrapersonal intelligence dimension.

Uzoğlu (2006) determined the effect of gender on visual-spatial intelligence, intrapersonal intelligence, musical intelligence and verbal-linguistic intelligence dimensions. There is a meaningful relationship between visually impaired students' mathematics achievements in second level of elementary school and logical-mathematical intelligence, intrapersonal intelligence, verbal-linguistic intelligence and visual-spatial intelligence dimensions. In spite of this, there is not a meaningful relationship between visually impaired students' mathematics achievements and musical-rhythmic intelligence, interpersonal intelligence, and bodily-kinesthetic intelligence dimensions. However, Uzoğlu (2006) found in his study that there is a meaningful relationship between mathematics achievement and all multiple intelligence dimensions.

## RECOMMENDATIONS

1. The role of teaching methods is very big in many students to present negative attitudes towards courses (Kuloğlu, 2005). Teaching methods appropriate to visually impaired students' multiple intelligence dimensions might increase students' mathematics

**Table 4.** Multiple intelligence dimensions based on sight levels (independent samples t test results about students' seeing less and blind students' multiple intelligence dimensions scores).

| Intelligence dimensions | Gender | Number of students | Mean | Standard deviation | Independent samples t test | | |
|---|---|---|---|---|---|---|---|
| | | | | | t | df | p |
| Musical-rhythmic intelligence | Blind | 30 | 1.65 | 0.30 | 2.56 | 63 | 0.01 |
| | Seeing less | 35 | 1.38 | 0.47 | | | |
| Interpersonal intelligence | Blind | 30 | 1.48 | 0.29 | -0.77 | 63 | 0.44 |
| | Seeing less | 35 | 1.54 | 0.26 | | | |
| Visual-spatial intelligence | Blind | 30 | 0.70 | 0.47 | -5.02 | 63 | 0.00 |
| | Seeing less | 35 | 1.25 | 0.40 | | | |
| Verbal-linguistic intelligence | Blind | 30 | 1.18 | 0.45 | -0.74 | 63 | 0.46 |
| | Seeing less | 35 | 1.26 | 0.40 | | | |
| Logical-mathematical intelligence | Blind | 30 | 1.47 | 0.43 | -0.33 | 63 | 0.74 |
| | Seeing less | 35 | 1.51 | 0.32 | | | |
| Intrapersonal intelligence | Blind | 30 | 1.34 | 0.45 | 0.12 | 63 | 0.99 |
| | Seeing less | 35 | 1.34 | 0.26 | | | |
| Bodily-kinesthetic intelligence | Blind | 30 | 1.35 | 0.34 | -0.71 | 63 | 0.94 |
| | Seeing less | 35 | 1.36 | 0.31 | | | |

**Table 5.** The relationship between visually impaired students' mathematics achievement and multiple intelligence dimensions.

| Intelligence dimension | Mathematics achievement | | |
|---|---|---|---|
| | N | r | p |
| Verbal-linguistic intelligence | 65 | 0.42 | 0.00 |
| Logical- mathematical intelligence | 65 | 0.52 | 0.00 |
| Visual-spatial intelligence | 65 | 0.25 | 0.03 |
| Musical-rhythmic intelligence | 65 | 0.08 | 0.50 |
| Bodily-kinesthetic intelligence | 65 | 0.24 | 0.05 |
| Intrapersonal intelligence | 65 | 0.45 | 0.00 |
| Interpersonal intelligence | 65 | 0.19 | 0.12 |

achievements. For achieving this, mathematics commissions could prepare materials appropriate to students' multiple intelligence dimensions' for each topic in mathematics. Province and Country National Education Directorates could prepare education seminars about this issue.

2. If multiple intelligence dimensions of students in schools for visually impaired ones are determined, it would be useful to lead these students after their elementary education.

3. If visually impaired students' multiple intelligence dimensions are investigated and the lessons are performed appropriate to these dimensions, there would be more productive teaching-learning environments.

4. Based on the results of this research, the reasons of why visually impaired students are weak in some intelligence dimensions could be investigated.

5. It might be useful to conduct this research with a bigger sample.

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