Research Article

Comparison of Working and Visual Memory in Children with and Without Dyslexia

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Abstract

Objectives: This study aimed at comparing working and visual memory in children with and without dyslexia.

Methods: The sample consisted of 61 children without dyslexia and 64 children with dyslexia from third to sixth grade in elementary school. The inclusion criteria were children aged nine to 12 who had no history of medical eye disease and visual impairment, the exclusion criteria were mentally retarded children. Purposeful sampling was used to collect the data. The participants completed Wechsler forward and backward digit span test and Benton Visual Test. A multivariate analysis of variance (MANOVA) was used to analyze the data.

Results: Results showed that there was a significant difference between normal children and those with dyslexia regarding their direct memory ($F = 25.34$, $P < 0.001$, partial eta square = 0.18), backward memory ($F = 30.78$, $P < 0.001$, partial eta square = 0.21), and Benton Visual Retention ($F = 17.56$, $P < 0.001$, partial eta square = 0.13).

Conclusions: The performance of children with dyslexia was weaker than those without dyslexia in regards to their working and visual memory. The highest level of impairment was seen in backward, direct, and visual memory, respectively, in children with dyslexia. Theoretical and practical implications of the findings will be discussed.

Keywords: Learning Disorder, Dyslexia, Working Memory, Benton Visual Retention

1. Background

Learning disorder refers to a condition that might affect acquisition, organization, memorization, understanding or the use of verbal or nonverbal information (1). This disorder is known as a permanent condition related to cognitive neuroscience, which significantly affects individuals' learning abilities (2). Learning disability is concerned with a remarkable reduction in understanding new or complex information and learning new skills (3). Learning disabilities result from a disorder in one or several processes involved in perception, thinking, memorization or acquisition, having different levels of severity, or having one or several of the following symptoms: oral language (listening, speaking, and understanding), reading (e.g. decoding, phonetic knowledge, word recognition, and comprehension), written language (e.g. spelling and written expression), and mathematics (e.g. computation, problem solving) (1). Most children with learning disabilities do not show any signs of problems except when they have spe-cific scientific tasks, which challenge their cognitive processing. One of the basic features of specific learning disability is persistent problems in learning basic academic skills, which begin during the years of formal schooling. The second feature is that an individual's performance in the areas of academic skills, which has been affected, is well below age average. The third feature is that learning problems in the first beginning years are evident in most individuals. These problems are not caused by intellectual disability, overall delayed growth, auditory or visual impairment, or other neurological or motor disorders (4).

The prevalence of specific learning disability in reading, writing, and mathematics of 5% to 15% of elementary school children is different in different cultures and different languages. However, this prevalence is unknown in adults but it seems to be about 4% (4). There are several pieces of evidence regarding the rate of the prevalence of learning disability in Iran. In a study done by Rahimian Boogar and Sadeghi (5) on male and female elementary school children of Shahreza, it was shown that 10.8%, 9.5%,

8.2%, 6.9% of boys and 5.9%, 4.4%, 3.5%, and 2.8% of girls in the second, third, fourth, and fifth grades of elementary school had dyslexia, respectively. Another study, which was done by Behrad (6), measured the prevalence of learning disabilities of elementary children in Iran. The findings indicated that the overall prevalence was 8.8% among both genders, 6% of which belonged to boys, and 4.5% to girls.

One of the most common types of learning disabilities is dyslexia, meaning that learning problems are caused by inability in phonological processing. Dyslexia is also classified as a specific or developmental learning disability (7). Dyslexia is usually described as having a problem with letters of the alphabet, word recognition, decoding, and comprehension. In DSM-5, the term "dyslexia" has not been used, instead the term "neuropsychological disorders" has been applied which, among all different disorders that began at pre-school level and before that, only learning disorder and communication disorder are included. There are three different forms of reading disorders and seven forms of communication disorders (8). Specific reading difficulty is a common progressive disorder, which is found in about 5% to 10% of school children. Most dyslexic children have a problem in a part of visual system, which is vital for visual-event scheduling and controlling eye movements (9).

One of the significant features of these children is disorder in their memory functions (10). Verbal working memory in individuals who have dyslexia is defective (11). Working memory refers to temporary storage and manipulation of visual and verbal information. This working memory system consists of a specific domain of storage systems of phonological loop, visuospatial sketchpad, and central executive (12). One of the most influential models of working memory is a framework proposed by Baddeley in 1974 (13). Baddeley and Hitch introduced a prominent multicomponent model of working memory. According to their theory, the central executive regulates the reception of information from working memory through allocating attentional resources (14). Phonological loop stores verbal information temporarily. Visuospatial sketchpad stores visuospatial information temporarily (15). Working memory is important for a wide range of activities such as attention control, problem solving, listening, and reading comprehension. Evidence suggests that poor performance in working memory is correlated with poor academic achievement and poor learning outcomes (16). Individuals who have problems in the area of reading (literacy) or language processing are similar to those dyslexic people who tend to show memory profile with poor phonological loop and central executive (verbal working memory) (16).

Kibby et al. (17), investigated the relationship between developmental reading disability and working memory and found that children with developmental reading dis-

ability have visible disability in working memory. Wang and Gathercole (18) found that children with reading disability have severe impairment in simple and complex span tasks. In another study, Gathercole et al. (19), investigated the working memory of children with dyslexia. They found that working memory is an important factor in learning reading skills and mathematics. Saadati Shamir et al. (20), examined the relationship between working memory, reading performance, and academic achievement of male bilingual and monolingual children. The results showed that the direct effect of working memory on reading performance and academic achievement is significant and positive in both groups. A study conducted by Beneventi et al. (21), showed that children with reading disability have a weaker working memory compared to those in the control group.

Another problem associated with children's memory problems is related to visuospatial perception. In fact, we can say that visuospatial perception is a process done in the right hemisphere of the brain and includes the ability to recognize the position of objects and shapes in relation to each other and the person himself/herself (22). Most of the people who have visually impaired memory are children with a learning disability (23). Parvandi (24) compared the visual-motor perception of dyslexic and hyperactive children and children with ADD with normal children and found that this ability is higher in normal children compared to the other two groups. Goulandris and Snowling (25) conducted a case study on visual memory deficit of an individual and found that his reading and spelling problems were due to his visual memory deficit. Sensory processing deficit in dyslexic individuals is in the auditory and visual areas (26). Evidence suggests that dyslexic readers have a disorder in successive naming tasks, which require simultaneous activation of visual and phonological representation (27). In another study, Menghini et al. (11), showed that dyslexic children have deficiency in performing verbal and visuospatial tasks as well as visual-verbal memory of objects. They also showed that working memory deficits in developmental dyslexia were not limited to phonological disorder, however, it included visuospatial and visual information of the object as well. The findings of this study are in line with those of Afsharian et al. (28). They showed that the visuospatial ability and memory of normal children was more than that of dyslexic ones.

A part of research focuses on the disorders in the development of visual system, which is vital for visual-event scheduling and controlling eye movements. Another part of research emphasizes the deficits in visual and working memory. However, in recent studies, it is still unclear whether deficit in working memory or deficit in visual memory leads to dyslexia. The significance of this finding

lies in the fact that whether the focus should be put on enhancing working memory or visual memory. Another challenge, which was ignored in previous studies, was related to the sustainability of low performance in different years. A question that might be raised is whether the difference in visual and working memory performance in different years of development or in different educational levels remains sustainable or becomes worse. Based on these studies, the present study aims to compare working and visual memory in individuals with and without dyslexia considering the effect of grade.

2. Methods

A causal-comparative method was used in this study. The population of this study included all elementary children from third grade to sixth grade in Semnan, Iran, in the school year 2015-16. A total of 61 normal children (30 boys and 31 girls) and 64 dyslexic children (30 boys and 34 girls) were selected. The inclusion criteria were children aged 9 to 12 who, based on the academic records, had no history of medical eye disease, IQ more than 85, and visual impairment; the exclusion criteria were mentally retarded children. Purposeful sampling was used to collect the data. The researchers first referred to ordinary schools and asked the teachers to introduce two groups of children. Normal and abnormal children, who were identified by the teachers, were given a reading text. Those who mistakenly responded to 95% of the words of the text were identified as abnormal and those who correctly responded to 50% of the words of the text were identified as normal. All of the tests were administered individually in the schools. All children were given Wechsler forward and backward digit span test and Benton Visual Retention Test. The data were collected in one month. The average time used for taking the tests was 20 minutes. Since two groups were compared with regard to three dependent variables namely direct memory, backward memory, and visual memory, a multivariate analysis of variance (MANOVA) was used to analyze the data. SPSS 23 was utilized to analyze the data.

2.1. Ethics

The consent to participate in this study was taken from their parents for participants. All information regarding participants and their families remain confidential.

2.2. Wechsler Intelligence Scale

Wechsler intelligence scale for children (WISC) was developed in 1949 by Wechsler in order to measure children's intelligence. This scale has 12 subtests, two of which are considered as side subtests. Six tests were verbal and six of them were nonverbal. Wechsler intelligence scale was translated and adapted in Shiraz by Shahim (29) to measure children's intelligence aged six to 13 and was standardized on a sample of 1400 children (29). Wechsler intelligence scale was translated, adapted, and standardized by Sadeghi et al. (30), yielding coefficients of 0.65 to 0.95 through Cronbach's alpha and 0.71 to 0.86 through split-half method. The validity coefficient of the scale was found to be between 0.66 to 0.92.

2.3. Benton Visual Retention Test

This test measures visual perception, immediate visual memory, and visuo-constructive abilities. According to previous studies, the Benton Visual Retention Test (BVRT) performance is positively correlated with IQ (31). The original version of Benton Test has three shapes (D, C, E), which has been standardized by the authors of this article. It can be made in four different ways. The BVRT can be applied to diagnose visual memory and useful visual abilities. A study done by Mohabbat (32) examined the reliability and validity of the BVRT in diagnosing the brain damage of children aged 8 to 10 in Tehran and yielded the reliability coefficient of 0.749 of the two parallel forms through Foley reconstruction and 0.692 through deferred reconstruction. The reliability coefficient of Form C through the two methods was 0.807 and for Form D was 0.830. Hassanpour (33) assessed the validity of the test using discriminant and convergent validity as 21% for true scores, and 18% for error scores. He also assessed the reliability using test-retest method as 77% for true scores and 84% for error scores.

3. Results

Results showed that the average performance of direct memory access in children with dyslexia was lower than normal children in all grades. Among children with dyslexia, the average performance of direct memory access was lowest in the fourth grade compared to all other grades. Average backward memory access in children with dyslexia was lower than that of normal children in all grades. The average backward memory access of dyslexic children in grade four was lower than those in other grades. The Benton's memory score of children with dyslexia was lower than normal children in all grades. The Benton's memory score of children in grade three was lower than that of other grades (Table 1).

A multivariate analysis of variance (MANOVA) model was used to analyze the data. First, the assumptions of the model were tested. The results showed that the assumption of the homogeneity of variance-covariance was met (Box'M = 51.65, F = 1.11, P > 0.05). The next assumption

Table 1. Mean and Standard Deviation of the Performance of Direct, Backward, and Visual Memory Based on Grade[a]

Grade	Dyslexic Children	Normal Children
Direct memory		
Third	5.77 ± 1.64	5.00 ± 1.89
Fourth	5.94 ± 1.30	4.24 ± 1.30
Fifth	5.93 ± 1.14	4.60 ± 1.30
Sixth	6.25 ± 1.39	4.78 ± 0.97
Backward memory		
Third	3.85 ± 1.28	2.79 ± 0.85
Fourth	5.11 ± 1.23	2.71 ± 1.05
Fifth	4.43 ± 1.28	4.06 ± 1.28
Sixth	4.81 ± 1.68	3.33 ± 1.87
Benton		
Third	6.15 ± 1.86	4.16 ± 1.67
Fourth	6.05 ± 0.87	4.38 ± 1.80
Fifth	6.71 ± 1.85	6.06 ± 1.94
Sixth	6.75 ± 1.84	5.78 ± 1.71

[a] Values are expressed as mean ± SD.

was the use of multivariate tests, which indicate a significant relationship among dependent variables. The results showed that there was a significant relationship between dependent variables ($X2Bartlett = 12.94$, $P < 0.05$). In addition, the assumption of the homogeneity of between-group variance in direct memory ($F_{7, 17} = 1.02$, $P > 0.05$), backward memory ($F_{7, 17} = 1.45$, $P > 0.05$), and visual memory ($F_{7, 17} = 1.48$, $P > 0.05$) was met. Therefore, a multivariate analysis of variance model was used to analyze the data. The results of the multivariate tests showed that the main effect was significant (Wilks' Lambda = 0.629, $F_{3, 115} = 22.63$, $P < 0.001$, Es = 0.37), the effect of school grade was significant (Wilks' Lambda = 0.829, $F_{9, 280.03} = 2.499$, $P < 0.01$, Es = 0.06), and the effect of group interaction on grade was not significant (Wilks' Lambda = 0.885, $F_{9, 280.03} = 1.601$, $P > 0.05$, Es = 0.04). Given that the multivariate tests were not significant regarding the interaction effect, univariate tests were run for main effects. The results of univariate tests indicated (Table 2) that there was a significant difference between the two groups with regard to their direct memory ($F_{1, 17} = 25.34$, $P < 0.001$, Es = 0.18). Therefore, the average direct memory performance of the normal group (5.98) was higher than that of the other group that had disorder (4.62). There was a significant difference between the two groups regarding their backward memory ($F_{1, 117} = 30.78$, $P < 0.001$, Es = 0.21). This means that the average performance of normal group (4.60) was higher than that of the other group (3.14) regarding their backward mem-

ory. There was a significant difference between the two groups in terms of Benton Visual Retention ($F_{1, 117} = 17.56$, $P < 0.001$, Es = 0.13). This means that the average performance of the normal group (6.41) was higher than that of the other group that had disorder (4.91).

Given the significance of the effect of grade, follow-up tests were run. The results of two-by-two comparison of grades showed that there was a significant difference between the third and the fifth grade regarding their backward memory (D = 0.93, $P < 0.05$). In Benton Visual Retention Test, there was a significant difference between the third and the fifth grade (D = 1.23, $P < 0.05$) as well as a significant difference between the fourth and fifth grade (D = 1.17, $P < 0.05$). Results showed that the backward memory performance and especially visual memory increased in the fifth grade compared to the third grade. The effect sizes of increased performance in the fifth grade compared to the third grade in backward and visual memory were 0.07 and 0.01, respectively.

4. Conclusion

This study aimed at comparing forward and backward digit span memory with visual memory of children with and without dyslexia using Wechsler and Benton tests. The results indicated that children with dyslexia have a lower performance in digit and visual memory compared to normal ones. These results are in line with those of Beneventi et al. (21). Beneventi et al., found that these children had a lower working memory compared to those in the control group. Similarly, the results of this study are consistent with those of Menghini et al. (11). They showed that dyslexic children are defective in doing verbal, visual, and spatial tasks, as well as verbal-visual memory. The working memory deficiency in developmental dyslexia is not limited to phonological disorder, however, it includes the visuospatial information of the object. The results of this study are in line with those of Afsharian et al. (28). They showed that the visuospatial ability and memory of children in the normal group was higher than that of the dyslexic group. Thus, it seems that dyslexic readers have the disorder, which requires simultaneous activation of visual and working memory, however, apparently working memory is more important than visual memory.

Another finding of this study was related to the effect size. The results showed that the effect size was larger for direct and backward working memory compared to visual memory. In fact, the largest effect size was observed for the backward memory. This evidence suggests that a decrease in working memory performance, especially in backward memory, was greater compared to visual memory. This result is the unique finding of this study. Although previous

Table 2. Sum of Squares, Mean Square, and Effect Size Based on Group, Grade, and Group Interaction Effect on Grade

Source	Sum of Square	df	Mean Square	F	P Value	Effect Size
Group						
Direct memory	51.14	1	51.14	25.34	0.001	0.18
Backward memory	51.49	1	51.49	30.78	0.001	0.21
Benton	51.41	1	51.41	17.56	0.001	0.13
Grade						
Direct memory	2.98	3	0.99	0.49	0.69	0.01
Backward memory	14.56	3	4.85	2.90	0.038	0.07
Benton	39.22	3	13.07	4.47	0.005	0.10

studies discussed the problems associated with working and visual memory in dyslexic individuals, it was not clear which type of memory had more problems in dyslexic individuals. Based on this finding, it can be inferred that the problem in working memory is more serious than in visual memory.

Another challenge was related to the sustainability of low performance in different years. It might be raised if whether the difference in visual and working memory performance in different years of development or in different educational levels remains sustainable or becomes worse. The findings of this study showed that the backward memory performance and especially visual memory increased in the fifth grade compared to the third grade. Thus, by the development, the deficits of memory will compensate.

The first limitation of this study is that purposeful sampling is used; therefore, it has limited generalizability. Researchers warn against illegitimate generalizability. Another limitation of this study is related to the design of the study. In this study, a causal-comparative design has been used. These types of designs are weak in terms of controlling intervening variables. There is the possibility that the observed differences were due to other variables (such as difference in intelligence scores). Furthermore, due to restricted access, there was no possibility of controlling intervening variables. Although retarded individuals are sent to special schools through screening tests, the IQ level difference between them can function as an intervening variable. The findings of this study indicated that the performance in backward memory, especially visual memory, increased in the fifth grade compared to the third grade. Based on this, researchers are recommended to use longitudinal designs in their future studies. It is suggested that this study be repeated on other communities to collect more evidence for the generalizability of the findings of this study.

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Footnotes

Authors' Contribution: Siavash Talepasand designed the study and analyzed the data. Mohaddese Eskandaripour wrote a draft article and collected the data. Ali Taghinezhad translated the article and presented the constructive suggestions.

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References

1. Lyon GR. Learning disabilities. *Future Children.* 1996;**6**(1):54–76. doi: 10.2307/1602494.
2. Mafra H. Development of learning and social skills in children with learning disabilities: An educational intervention program. *Proced Soc Behav Sci.* 2015;**209**:221–8. doi: 10.1016/j.sbspro.2015.11.220.
3. Castell E, Stenfert Kroese B. Midwives experiences of caring for women with learning disabilities - A qualitative study. *Midwifery.* 2016;**36**:35–42. doi: 10.1016/j.midw.2016.02.001. [PubMed: 27106942].
4. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders (DSM-5®).* United States: American Psychiatric Pub; 2013.
5. Rahimian Boogar E, Sadeghi A. [Perevalence of reading disorder in primary school children]. *Iran J Psychiatry Clin Psychol.* 2007;**12**(4):396–402. Persian.
6. Behrad B. [Meta analysis of the prevalence of learning disabilities among primary children]. *Except Child.* 2006;**18**(4):417–36. Persian.
7. Tormanen MRK, Takala M, Sajaniemi N. Learning disabilities and the auditory and visual matching computer program. *Support Learn.* 2008;**23**(2):80–8. doi: 10.1111/j.1467-9604.2008.00374.x.
8. Moradi S. [The nature and classification of reading disorders (critique of the DSM 5 proposals for this disorder)]. *J Except Educ.* 2014;**14**:59–69. Persian.
9. Stein JF, Richardson AJ, Fowler MS. Monocular occlusion can improve binocular control and reading in dyslexics. *Brain.* 2000;**123 (Pt 1)**:164–70. doi: 10.1093/brain/123.1.164. [PubMed: 10611130].

10. Kajbaf MB, Lahijanian Z, Abedi A. [A comparison of memory profile in normal children and children with learning disabilities in dictation, mathematics and reading]. *Adv Cogn Sci*. 2010;**12**(1):17–25. Persian.

11. Menghini D, Finzi A, Carlesimo GA, Vicari S. Working memory impairment in children with developmental dyslexia: Is it just a phonological deficit? *Dev Neuropsychol*. 2011;**36**(2):199–213. doi: 10.1080/87565641.2010.549868. [PubMed: 21347921].

12. Baddeley A. Working memory. *Science*. 1992;**255**(5044):556–9. doi: 10.1126/science.1736359.

13. Sobczak-Edmans M, Ng THB, Chan YC, Chew E, Chuang KH, Chen SHA. Temporal dynamics of visual working memory. *Neuroimage*. 2016;**124**(Pt A):1021–30. doi: 10.1016/j.neuroimage.2015.09.038. [PubMed: 26427643].

14. DeDe G, Ricca M, Knilans J, Trubl B. Construct validity and reliability of working memory tasks for people with aphasia. *Aphasiolog*. 2014;**28**(6):692–712. doi: 10.1080/02687038.2014.895973.

15. Asadzadeh H. [Investigate the relationship between working memory capacity and academic performance among grade school children in Tehran]. *Quart J Educ*. 2008;**25**(1):53–70. Persian.

16. Ghani KA, Gathercole SE. Working memory and study skills: A comparison between dyslexic and non-dyslexic adult learners. *Proced Soc Behav Sci*. 2013;**97**:271–7. doi: 10.1016/j.sbspro.2013.10.233.

17. Kibby MY, Marks W, Morgan S, Long CJ. Specific impairment in developmental reading disabilities: A working memory approach. *J Learn Disabil*. 2004;**37**(4):349–63. doi: 10.1177/00222194040370040601. [PubMed: 15493406].

18. Wang S, Gathercole SE. Working memory deficits in children with reading difficulties: Memory span and dual task coordination. *J Exp Child Psychol*. 2013;**115**(1):188–97. doi: 10.1016/j.jecp.2012.11.015. [PubMed: 23403228].

19. Gathercole SE, Alloway TP, Willis C, Adams AM. Working memory in children with reading disabilities. *J Exp Child Psychol*. 2006;**93**(3):265–81. doi: 10.1016/j.jecp.2005.08.003. [PubMed: 16293261].

20. Saadati Shamir A, Kiamanesh AR, Kadivar P, Hamidi MA. [The relationship between working memory, reading performance and academic achievement of monolingual and bilingual boy students]. *Quart J Educ Innovat*. 2010;**9**(35):89–124. Persian.

21. Beneventi H, Tonnessen FE, Ersland L, Hugdahl K. Working memory deficit in dyslexia: Behavioral and FMRI evidence. *Int J Neurosci*. 2010;**120**(1):51–9. doi: 10.3109/00207450903275129. [PubMed: 20128672].

22. Saif Naraqi M, Naderi E. *[Special failure in learning]*. Tehran: Mecca; 2005. Persian.

23. Hallahan DP, Kauffman JM. *Exceptional children: Introduction to special education*. 5th ed. Needham Heights, Mass: Allyn and Bacon; 1991.

24. Parvandi M. *Compare the visual perception of movement and flexibility in children with ADHD / dyslexia and attention deficit normal. [dissertation]*. Islamic Azad University (Tehran Centeral Branch); 2012.

25. Goulandris NK, Snowling M. Visual memory deficits: A plausible cause of developmental dyslexia? Evidence from a single case study. *Cognit Neuropsychol*. 1991;**8**(2):127–54. doi: 10.1080/02643299108253369.

26. McAnally KI, Castles A, Stuart GW. Visual and auditory processing impairments in subtypes of developmental dyslexia: A discussion. *J Dev Physic Disabilit*. 2000;**12**(2):145–56. doi: 10.1023/a:1009459622805.

27. Araujo S, Faisca L, Reis A, Marques JF, Petersson KM. Visual naming deficits in dyslexia: An ERP investigation of different processing domains. *Neuropsychologia*. 2016;**91**:61–76. doi: 10.1016/j.neuropsychologia.2016.07.007. [PubMed: 27422537].

28. Afsharian N, Yaryari F, Amin Alraya F, GhelichySeke M. [To compare visual-spatial abilities and memory in children with and without reading disorder]. *Except Child*. 2014;**4**:69–78. Persian.

29. Nazari S, Coty E, Sayyahi H. [The diagnostic criteria revised Wechsler intelligence scale learning disorders in children]. *J Spec Educ*. 2012;**109**(1):36–45. Persian.

30. Sadeghi A, Rabiee M, Abedi MR. [Validation and reliability of the Wechsler Intelligence Scale for children- IV]. *Dev Psychol*. 2011;**7**(28):377–86. Persian.

31. Messinis L, Lyros E, Georgiou V, Papathanasopoulos P. Benton Visual Retention Test performance in normal adults and acute stroke patients: Demographic considerations, discriminant validity, and test-retest reliability. *Clin Neuropsychol*. 2009;**23**(6):962–77. doi: 10.1080/13854040902740691. [PubMed: 19259889].

32. Mohabbat S. [Benton Visual Retention Test the reliability and validity in diagnosis of brain damage-year-old children in Tehran 8-10]. *The First Seminar on Research Findings in Special Education*. 20-21 May; Shiraz. Fars Special Education Supervisions - Shiraz University; 2001. Persian.

33. Hassanpour A. *[Standardization retention - Meet Benton children 8 and 9 years old in the city of Tabriz elementary schools in the academic year 2000-2001]. [dissertation]*. Tabriz University; 2002. Persian.