Examining the relationship between Students working memory capacity and their gender

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Abstract

The present study was conducted to determine the relationship between students' working memory scores and gender. The study data was gained from 36 Female students with a mean age of 9.86 and 36 male students with a mean age of 9.77 who were educating in the 92-93 school year and were selected using purposive sampling. Then, the working memory subtest of “Tehran - Stanford Binet Intelligence Scale ” and the working Memory subtest of "Wechsler intelligence scale for children" were conducted on both groups in order to determine the capacity of working memory.

Since there is no significant difference between the mean age of male and female subjects (t=0.318, df=35, & p>0.05), so the relationship between working memory score and gender can be examined in these two groups. Examining the difference between mean working memory scores of male and female subjects in working memory subtest of "Tehran - Stanford Binet Intelligence Scale " (t=1.704, df=35 and p>0.05) and working memory subtests of "Wechsler intelligence scale for children" (t=1.012, df=35 and p>0.05) revealed that with a 95% confidence level as it is common in psychology, gender plays no role in the working memory.

Keywords: working memory, gender, working memory capacity

1-Introduction

Working memory was first introduced by Baddeley and Hitch (1974). They argued that the concept of short-term memory must be replaced by the concept of working memory [2]. Baced on Baddeley (2001) and Repovz and Baddeley (2006) Working memory has four central executive operating component that consists of main component, phonological loop, visual-spatial area and an events temporary storage [3]. Each of these components saves special kinds of information. Phonological loop stores verbal information, visual-spatial area stores visual information, and these two subsectors are directly in contact with central executive which is responsible for coordinating with cognitive system[9]. Eventual temporary storage also keeps and integrates existing information in the phonological loop, visual-spatial area, and long term memory [3].

Nowadays, educational psychology believes that learning involves optimum use of working memory. Working memory is our ability to information recall, information processing, and information management, and it plays fundamental role in a wide range of complex learning activities such as comprehension, reading, arithmetic, and problems about words, and even simple tasks such as transcription of the board and orientation [1]. Working memory is base of learning and it is a basic cognitive skill that determines our potential ability to learn, and due to some experts opinion it is even more important than IQ [1].

Working memory is the most important component of executive functions [18] which help human to live, do learning homework, and intelligent act [14]. It also influences on a wide range of cognitive abilities particularly engaging with information interference and conflict or distraction, so it predicts necessary cognitive abilities and academic achievement of children [18].

This cognitive structure is a term refers to a high level skill to allocate attention resources despite interference or distraction [12] and measures the simultaneous storage capacity and manipulation of information [13]. This concept that relates to attention skills, problem solving and impulse control is closely correlated with fluid intelligence and is a firm indicator for determining the extent of educational and career success.
Since the poor working memory is associated with poor attention skills, so it can be cause of attention deficit-hyperactivity disorder (ADHD) and other learning problems [20]. Stanford Research Institute (1989) has reported that the prevalence of learning disabilities is about 5 to 10 percent among school students [5].

The importance of working memory in learning is not bounded to children and it is important in all learning homework and all ages. Deficiency in working memory negatively affects different aspects of cognitive processes [1]. The working memory also affects our socialization, because it requires storing and retrieving information of our environments. Working memory is important at any age range and its deficiency can cause learning and even career problems [15].

Working memory capacity significantly increases during childhood [10] and has a marked change in each age interval [11]. Generally the memory extent quickly increases in age of 4 to 8 and after that it is growing gradually till age 12 [17]. Then in adulthood till about age 20 it reaches to the highest point and remains constant [1]. Working memory unlike IQ is not related to parental education level and socio - economic situation, and children despite of the past or environmental effects can be provided an equal opportunity to strengthen working memory [1].

Since the main component of executive function is working memory [19] it helps to humans in life, learning and intellectual act [14]. Also it affects on a wide range of cognitive abilities, especially engaging with information conflict and interference or distraction [19], so prediction of cognitive ability level and raising this workbench of storage system is important [8].

Visual-spatial working memory and verbal working memory are checked in order to examine the capacity of working memory. Researches show that visual-spatial working memory performance of male students and verbal working memory performance of female students is usually better in is better [16] But on the whole the total capacity of working memory doesn’t relate with gender [16, 21 and 22]. Since the working memory performance can be raised by cognitive exercises, so deleting the gender factor can lead equal cognitive opportunity for boys and girls and helps to elimination of this belief that gender affects learning. Therefore, this study was conducted to determine the relationship between working memory capacity and gender.

2 – Methodology

The study statistical population, which based on the research goal, is in the category of descriptive researches from the kind of correlational includes all children in third, fourth and fifth grades of elementary school. Sample group consists of 72 students includes 36 male and 36 female that were educating in 92-93 school year, and they were selected by convenience sampling method through approaching to Tehran and Kish Island schools. Then to examine the relationship between gender and the capacity of working memory, working memory subtest of "Tehran - Stanford Binet Intelligence Scale” and Working Memory subtest of "Wechsler intelligence scale for children” were conducted on both groups in order to determine the capacity of working memory.

3 - Research Tools

3.1 - Working Memory subtests of Tehran Stanford Binet Intelligence Scale

The new version of Tehran Stanford Binet Intelligence scale was developed by Afrooz and Kamkari in 1387, with a detailed review of the fifth edition of the Stanford - Binet in 2003 [6].

Tehran - Stanford Binet Intelligence Scale has 10 subtests that two of them are connected with working memory IQ measurement. This point of view that was proposed by Badeley (1986) nowadays is known as the essential and constructive component of intelligence in school learning [6]. In this stratified test, memory process, which saves a variety of information into long-term memory and inspect, store, or transfer them, is recognized as working memory [6].

Verbal working memory subtests, will continue from level 2 to 6. At Level 2, 3 simple sentences, and at level 4, 5, and 6 compound sentences arise. To remember the last word in these sentences is started from level 4 and continued to level 6 [6].

Nonverbal working memory subtests is continued from level 1 to 6. In first level delayed responses and neural rejects are took into consideration and in level 2, 3, 4, 5, and 6, the process of hitting the green cubes are
followed. At Level 2, a maximum of two cubes and in Level 3 a maximum of 3 cubes is knocking. At level 4, the number is five cubes, in level 5 it is 7 cubes, and in level 6 it becomes 8 cubes, and some complexities with emphasis on yellow and red cubes placed in rows are brought up [6].

Finally, working memory IQ is determined using verbal and nonverbal working memory subtests total level scores.

3-2 - Wechsler Intelligence Scale sub-tests of working memory

Wechsler Intelligence Scale for children was conducted through a research in 16 areas of Chaharmahal and Bakhtiari province on 900 person, according to the recommendation of education organization of this province and under the control of Esfahan university after translating and adaption with Iranian culture, and Normal tables with a survey of 872 responses were obtained by Abedi et al [7]. Wechsler Intelligence Scale sub-tests of working memory are:

1) Digit span. 2) The sequence of letters and numbers.

To conduct the forward digits span test, subject repeats the numbers in the same way that examiner read them aloud. For reversed digit span the subject repeats numbers in reverse, and in this case, the numbers are also read out loud by the experimenter [7]. Digit span test has two episodes that are run separately, that means each of which is executed regardless of the score in the other subjects [7]. The maximum score in forward test and for reverse is both 16, so the total maximum score is 32 [7]. Then we obtain standard score according to standard tables of grades and test scores of the subjects.

Letter and number sequencing subtest of the Wechsler Intelligence Scale asks participants to repeat numbers in ascending order and words in alphabetic order [7]. Each question consists of three attempts. Diagnosis questions are used for children 6 to 7 years old to determine that the child knows the alphabet and counting. If participant is unsuccessful in identifying questions, we will do arithmetic subtest [7]. However, in this study we did not need to do arithmetic subtests because of participant’s ages.

4 – Results

Demographic data of the study show that 41.7 percent of the subjects are enrolled in the third grade, 41.7% in the fourth grade and 16.7 percent in the fifth grade of primary school. The age means of Subjects is 9.82 and 50% of them were female and 50 percent were male.

Table 1 show that the mean scores of working memory Binet scale of female is103.00, and in the wechsler scale it is 107.77. According to this table, the average working memory test scores of male subjects in the Binet scale equal to 95.50 and in the Wechsler scale it is 104.11. Lowest score and the highest score of the subjects are reported in the following table according to their gender.

<table>
<thead>
<tr>
<th>Group</th>
<th>scale</th>
<th>mean</th>
<th>SD</th>
<th>minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Girls</td>
<td>Tehran-Stanford binet</td>
<td>103.00</td>
<td>17.32</td>
<td>74</td>
<td>135</td>
</tr>
<tr>
<td></td>
<td>Wechsler</td>
<td>107.77</td>
<td>13.55</td>
<td>83</td>
<td>136</td>
</tr>
<tr>
<td>Boys</td>
<td>Tehran-Stanford binet</td>
<td>95.50</td>
<td>15.61</td>
<td>65</td>
<td>129</td>
</tr>
<tr>
<td></td>
<td>Wechsler</td>
<td>104.11</td>
<td>12.68</td>
<td>75</td>
<td>134</td>
</tr>
</tbody>
</table>

Based on Table 2 the mean age for female subjects is 9.861 and for male subject is 9.777.

Table 3 shows that the mean age for these two groups have no significant difference, based on the dependent t-test, t=0.318, and the significance ratio is 0.753, that is more than 0.05, and indicates that there is no significant difference between the means of ages.
According to above by eliminating the changing growing effect because male and female subjects are equal, we can now examine the differences between working memory mean scores of girls and boys. Table 4 shows the mean scores of working memory in gender dissociation and intelligence scale test. According to this table, we notice that with 95% confidence level as is common in psychology, gender has no effect on the score of working memory.

Table 4 - T-dependent test of working memory mean scores based on gender dissociation

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>standard deviation</th>
<th>Mean deviation error</th>
<th>t</th>
<th>degrees of freedom</th>
<th>significant coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Binet</td>
<td>6.166</td>
<td>21.715</td>
<td>3.619</td>
<td>1.704</td>
<td>35</td>
<td>0.097</td>
</tr>
<tr>
<td>wechsler</td>
<td>2.888</td>
<td>18.622</td>
<td>3.103</td>
<td>0.931</td>
<td>35</td>
<td>0.358</td>
</tr>
</tbody>
</table>

5 – Argument and Conclusion

the present study was conducted to investigate this hypothesis that working memory scores of students is not related to their gender. Dependent t-test was used to examine the hypothesis. Since there was no significant difference between the mean age of male and female subjects (t=0.310, df=35, p>0.05), the relationship between working memory score and gender in the two groups were examined. Examining the difference in mean scores of working memory subtest of Tehran - Stanford Binet Intelligence Scale (t=1.704, df=35, and p>0.05) and working memory subtest of “Wechsler intelligence scale for children” (t=1.012, df=35, and p>0.05) revealed that with 95% confidence level as is common in psychology, gender has no effect on the score of working memory.

The results of this research are aligned with the findings of researchers [16, 21 and 22]. Among the limitations of this research study, there is the possibility of such random assignment of people like experimental studies that is a research limitation which was not verified in this study.

It is recommended that this research will be conducted by using random samples and considering the larger sample size at different ages.

References