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Abstract

The aim of the study is to investigate the effects of using computer for developing arithmetical skills of students with mathematics learning difficulty (MLD). The study was carried out with pre-test –post-test single subject research design. The participants of the study consist of a girl and two boys who attend 3rd grade at elementary school. The contents of the computer-aided instruction materials consist of counting skills, place value and addition subjects which are related to 1st and 2nd grade mathematics course learning outcomes of primary school. The materials have been prepared in the light of educational neuroscience findings about mathematical cognition. Participants were given a total of 75 lessons of individual instruction for five weeks, every day on weekdays and 20-30 minutes a day with the materials developed. Achievement tests developed by the researcher were used as data collection tools. Test response times and correct answers of the participants were identified in the achievement tests. It was found that progress was achieved in counting skills and place value concepts and they could solve addition problems. However, it was revealed that the difficulties of students at the second grade level continued with addition, especially when the numbers were given side-by-side. It can be stated that computer assisted instruction used in this study developed students’ arithmetical skills and increased their speed. Triple code and the models which help reduce the workload of working memory are advised to be used in the instruction of the students having MLD.

Introduction

Mathematics learning difficulty (MLD / Dyscalculia) is a difficulty in learning or comprehending arithmetic and it is a common term especially used to describe the lack of mathematical skills related to arithmetic and solving arithmetic problem (Karagiannakis, Baccaglini-Frank, & Papadatos, 2014). Such expressions like mathematics learning disability/ difficulties, calculation disorientation, mathematics-arithmetic inability and specific learning disorder in arithmetic are different names used for the difficulties encountered in mathematics. However, MLD can be preferred due to the existence of situations of difficulty and different causes of difficulty (Gersten, Jordan, & Flojo, 2005). While Piazza and colleagues (2010) define MLD as possessing inabilities for the acquisition of mathematical knowledge and skills, von Aster & Shalev (2007) cite that developmental dyscalculia is a specific learning difficulty which affects the normal acquisition of mathematical skills and genetic, neurobiological, and epidemiological evidence related to dyscalculia like the other specific learning disabilities indicate that dyscalculia is a brain-based disorder.

Despite the non-existence of such conditions like mental retardation, emotional disorders, cultural deprivation and lack of education, a student’s mathematical performance is substantially below that expected for age, intelligence, and education and it is defined as MLD (Büttner & Hasselhorn, 2011). International Classification of Diseases (ICD) explained that developmental dyscalculia cannot be explained with mental retardation, low social environment or lack of education but with an inconsistency between normal intelligence and mathematical performance (World Health Organization, 1992).

Individuals suffering from MLD have difficulty in grasping basic number concepts, lack intuitive understanding of number sense, and have problems while learning numerical conditions and how to manipulate them. Although they give the right answer or use the right method, they do what they have done mechanically and incredulously (Department for Education and Skills. 2001). They have difficulties with basic arithmetic operations (Shalev et al., 2001) and using operations based on recalling for solving word problems (Geary, 2004). They demonstrate difficulties with estimating numbers’ magnitude and size. They are unqualified to understand number relationships (Sharma, 2015). They are slow to comprehend and operate with numbers (Ansari & Karmiloff-Smith, 2002; Geary, 2004). They use very simple strategies like finger counting which their peers stopped using it for a long time ago even with very basic operations (Jordan, Hanich, & Kaplan, 2003).

It is quite important to identify each individual child's strengths and weaknesses , and to investigate particular misconceptions, incorrect strategies that they use and to give training within this context (Dowker, 2009) and it is necessary to understand what children's cognitive capacities are in order to develop a program which will help to promote their cognitive capacities (De Jong et al., 2009). In addition, it is beneficial to consider neuroscience findings about mathematical cognition for developing a more effective program. Many brain-imaging studies have been carried out about mathematical cognition and important findings have been obtained (Deheane et al., 2003; Menon et al., 2002; Rivera et al; 2005). The literature review of some of these findings are included in the following paragraphs.

Approximate number skill

Approximate number skill is a skill used to estimate numerical magnitude greater than four or when two numerosities are compared, it is used to identify which one is greater or smaller. It was revealed that infants could recognize numerosities three hours after they were born (Izard, Sann, Spelke, & Streri, 2009). Moreover, the differences in unlearned approximate number sense related to the differences in mathematics achievement are among the findings (Halberda, Mazzocco, & Feigenson, 2008), and numerical acuity of individuals who have MLD is problematic to the highest degree when it is compared to their peers (Piazza et al., 2010).

Exact Number Skill

Exact number skill, one of the components of numerical core knowledge, enables subitizing, the ability to see a small amount of objects, maximum four, and know how many objects there are without counting instantly and mental calculation. Subsidizing, a term described by Kaufmann and colleagues (1949; as cited in Desoete, Roeyers, ve De Clercq, 2004), refers to a fast (40-100 ms/item), an accurate and a reliable process by which a small number of quantitative numerosities can be enumerated. Children in early ages are building on the subsidizing their counting and cardinality knowledge. (Celement, 1999). Olkun and Özdem (2015) found that conceptual subsidizing practices increase the computational performance of low achievers.

Triple Coding

The triple code model was introduced by Dehaene (1992) and he claims that there are three main representations of numbers with different neurotic structures in human mind and different functions. These representations are called analogue or magnitude code, verbal code, and symbolic code. It is claimed that students suffering from MLD have problems during the transmission between the codes.

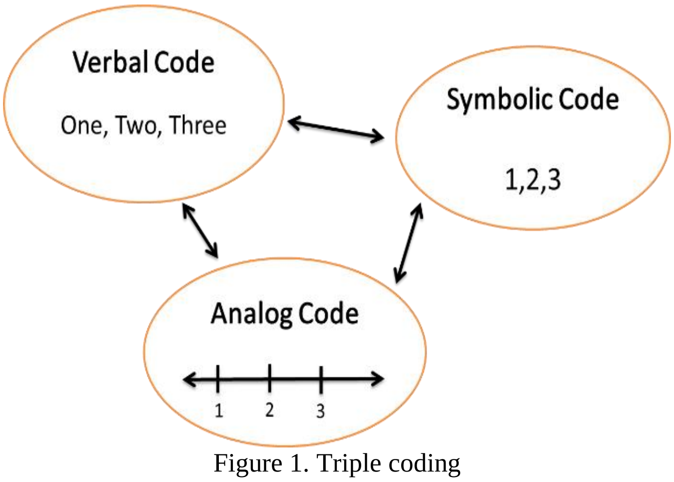

Figure 1. Triple coding

Distance Effect / Size Effect

While fulfilling the task of symbolic number comparison, the numerical differences between the number comparisons increase and distance effects occur which refer to the increasing rate of correct answers and decreasing response time (Dehaene, Dupoux, & Mehler, 1990; Moyer & Bayer, 1976). For example, a student finds the question which one is larger 7 or 8 more difficult than the question which one is larger 7 or 10. It was revealed that children with MLD showed larger distance effect than controls without considering number format (Mussolin, Mejias, & Noël, 2010). Moreover, it is found that the individual differences in distance effect are associated with mathematical achievement (Holloway & Ansari, 2009). The size effect indicates that it is difficult to identify the larger of two numerical quantities that are the same when compared to a smaller one. For example, an individual finds the comparison of 87 and 92 more difficult than 17 and 22 (Dehaene & Akhavein, 1995).

Working Memory

Working memory can be defined as an individual's ability to hold and manipulate mental representations of information while being simultaneously engaged in other cognitive tasks (Geary, Hoard, Byrd- Craven, Nugent, and Numtee, 2007). Many studies agree that individuals with MLD have lack of competency considering this type of memory (Geary, Hoard, Byrd-Craven, & DeSoto, 2004; Wilson & Swanson, 2001). Moreover, it is determined that individuals with MLD lag further behind their peers considering the capacity of working memory (Geary, Hoard, Byrd-Craven, & DeSoto, 2004). It was determined that students with MLD used finger counting constantly because working memory reduced workload and this condition had a positive effect on their performance (Geary, 1990). However, Lee and colleagues (2007) conducted a study in which the effects of symbolic algebraic expressions and modelling strategies on brain were compared and they determined that both strategies activated the brain regions involved in working memory and quantitative processes but modelling strategies made low demands from the resources related to attention. The findings point out that models including working memory problems should be used in training of students with MLD.

Number Disorientation

One of the problems which students with MLD experience is number disorientation (Baroody, Bajwa, ve Eiland, 2009; Desoete ve Grégoire, 2006). For example, while a student is able to solve "4+3=7" operation, they cannot retrieve the answer when the question is "3+4" (Mohd Syah, Hamzaid, Murphy, & Lim, 2015) or when a student is asked to compare the numbers "34 and 43, the student might say that both numbers are the same.

Computer Assisted Intervention

In mathematics education, materials used for teaching of concepts which are difficult to learn are very important. Using the correct materials make the lessons more effective and efficient. Teaching abstract concepts without using teaching materials to students makes it difficult to understand the concepts and connections between the concepts. Most of the mathematical concepts are abstract concepts which require a high-level cognitive activity. This structure of mathematical concepts causes students' learning to become complicated. It is possible to explain and stimulate most of these concepts with computer technologies.

By this way, most abstract concepts are concretized and they become much easier for students to comprehend (Baki, 2002). Maccini, Gagnon, ve Hughes (2002) state that technology based interventions hold great promise for the development of academic performance of students with learning difficulties and today technology has become a valuable tool including big potentials to support students with learning difficulties than ever before. Technology can be used as a supporting tool to develop and change the abilities of students with MLD (Poobrasert & Gestubtim, 2013).

In addition to this, it is important to remark that computers will not be able to solve the rooted problems (Aydın, 2005), computer assisted instruction plays an important role in mathematics interventions but it will not replace interaction with a teacher (Dowker, 2009), and computer assisted instruction (CAI) supported with individualized learning or instruction and teacher interaction will be able to make more contributions to students' achievement with MLD (Scheid, 2010).

This study seeks answers to the problem "what are the effects of using computer for developing arithmetical skills of 3rd grade students with MLD?" The answers were sought for the sub-problems given below to discuss the problem in-depth.

1.What are the effects of using computer on counting skills of students with MLD?

2.What are the effects of using computer on place value performance of students with MLD?

3.What are the effects of using computer on addition performance of students with MLD?

Method

Research Design

This study was carried out with pre-test –post-test single subject research design. Single subject research design is a quasi-experimental method in which findings related to a single subject or group of single subjects are interpreted (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2012; McLaughlin & Mertens, 2004). Because the subjects are not chosen randomly, single case studies are considered quasi-experimental. It is reported that single subject research design has been used in nearly one-third of the studies carried out about individuals with learning difficulties (Swanson and Lee, 2000). Single subject research design is applied when the sample size is one or when a number of individuals are considered as a group (Kırcaali İftar and Tekin, 1997).

Participants

The participants of the research consist of three students with MLD, one female and 2 males, studying in two different primary schools located in a city in the east of Turkey. The participants were determined using multiple filter method (MFM). In MFM, teacher views, dyscalculia pre-assessment test, dyscalculia screening tools, student recognition form, and intelligence test are used as a filter in the implementation.

M1. He is nine years and nine months old and he looks calm and quiet. However, when he comes together with his friends, he can be considered as one of the naughtiest children in school. He likes talking about his friends and events in his neighbourhood very much. He has got one sister and two brothers. M1 did not receive pre-school education. He continued his education in the same school and considering attendance, he did not play truant (total one month or more than a month) for a long time according to the school records. The data obtained from the interviews and observations carried out with him and his family reveal that M1 is normal in every aspect regarding health. M1 does not have any problems with hearing and seeing and he did not have an illness which would affect him for a long time.

F1. F1 is nine years and five months old. She looks older than her peers and she is social and friendly. She lives in their own house with her parents and two sisters aged 12 and 14. F1 did not receive pre-school education and when she was in the second grade, she changed her school and went to another school located in the same city. Considering attendance, she did not play truant (total one month or more than a month) for a long time. F1 does not have any problems with hearing and seeing. Moreover, she did not have any illnesses that affected her for a long time. The data obtained from the interviews and observations carried out with her and her family reveal that she is normal in every aspect regarding health.

M2. He is nine years and two months old. He can be identified as someone who keeps aloof from his friends and he is reserved. He loves spending time with his tablet. He reflects his interest in computers and computer games in his daily life talks. The school records document that M2 did not receive pre-school education and he did not play truant when participating in his lessons (total one month and more than a month). However, M2 was exposed to teacher change during his three-year education. M2 does not have any problems with hearing and seeing and also he did not have any illnesses that affected him for a long time. The data obtained from the interviews and observations carried out with him and his family reveal that he is normal in every aspect considering health.

Data Collection Tools

During the process of designing achievement tests, table of specifications were used. Preparing the table of specifications consist of determining teaching objectives, listing down the topics covered and directly associating test items and objectives by generating a two-way chart (Köse, 2012). Within this context, considering each sub-problem in the research, two achievement tests were designed referring to the levels of primary school 1st and 2nd grades within the framework of learning outcomes involved in learning and sub-learning domains of 2009 Primary School Mathematics curriculum. Two mathematics educators' views were taken for the tests prepared. Considering these views, necessary content and formal organizations were done. The values belonging to the tests' reliability analysis were presented in Table 1.

Table 1. Achievement tests' reliability measurements

	The Number of Item	**Cronbach Alpha**
Counting Skills Test-1	10	.834
Place Value Test-1	17	.861
Addition Test-1	21	.851
Counting Skills Test -2	15	.824
Place Value Test -2	25	.900
Addition Test-2	25	.867

Data Collection and Analysis

The data of the study were gathered via using achievement tests as pre-test and post-test. In the first lesson of each session, the relevant achievement test was used as a pre-test and it was used as a post-test in the last session. The starting and finishing time of the pre-tests and post-tests were recorded. Each item which the participants answered correctly in each test was scored 1 point and wrong items were scored 0 point.

Implementation Process

Dyscalculia Pre-Assessment Test used for identifying the participants was also administered to assess the participants' mathematics levels. When the students' forms were examined, it was found that these students had problems with adding two one digit numbers and answering questions about place value concepts like ones and tens. Because of that, the materials were developed considering the 1st and 2nd grade mathematics course learning outcomes. In computer assisted instruction materials, counting skills, concept of place value, and addition were taught respectively at 1st grade level and then at the 2nd grade level counting skills, concept of place value, and addition were taught. While developing the material, such neuroscientific findings as triple coding, approximate number skill, exact number skill, distance effect, distance/ size effect, and working memory were benefited from (For detailed information on material see Mutlu & Akgün, 2017, pp 123-126). The implementation was carried out in a primary school located in a city in the east of Turkey. The study lasted five weeks, five days a week and between 20 and 30 minutes on average and an individualized computer assisted instruction was given. Home page and menu page screen shot belonging to the materials were given below:

Figure 2. Course materials' home page and menu page screen shot

The implementation was carried out in six sessions. The first three sessions were about 1st grade mathematics course objectives and the last three sessions included 2nd grade mathematics course objectives.

Findings

In this section, the findings obtained from the achievement tests were given considering the order of the sub-problems of the study. The findings belonging to the participants were interpreted within the context of each problem.

Findings Related to the Counting Skills

In this section, within the context of sub-problem "What are the effects of using computer on counting skills of students with MLD ?", the findings obtained from the Counting Skills Test-1 and 2 were given. There are 10 items in Counting Skills test-1 and 15 items in Counting Skills Test 2. The counting skills of F1, M1, and M2 were presented below in order.

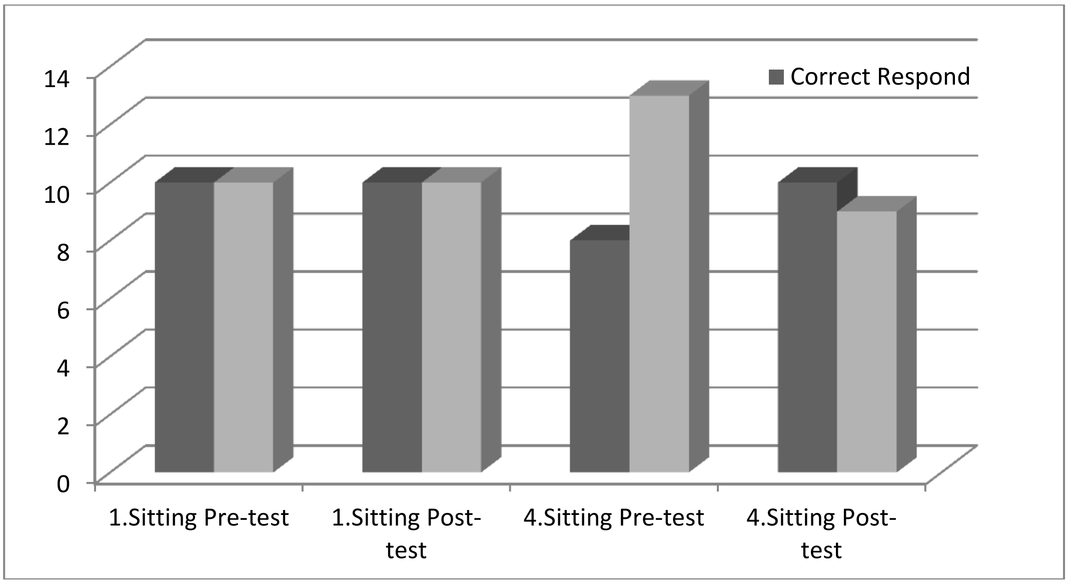

Figure 3. F1's counting skills test data

Figure 3 exhibits F1's pre-test and post-test results of Counting Skills Test 1 and 2 belonging to the 1st and 4th sessions of the individualized computer assisted instruction. When figure 3 is examined, it is seen that F1 answered total 10 questions correctly in the pre-test and post-test in Counting Skills Test-1. When the response time for the pre-test and post-test of Counting Skills Test- 1 is examined, it is found that the response time is equal. Because the anticipated fall in the response time was not actualized in the post test of F1's Counting Skills Test- 1, F1's post-test Counting Skills Test-1 was examined and it was determined that she tried to answer the items carefully and she explained the details which were not expected from her and that was the reason for a loss of time.

When F1's pre-test and post-test data of Counting Skills Test-2 is examined within the context of correct answers in Figure 3, it is found that she answered 8 items correctly out of 15 items in the pre-test and out of 15 items, she could answer 10 of them correctly in the post-test. When the response time for the pre-test- and post-test in Counting Skills Test-2 is considered, it is found that there was a significant difference between the response times and the response time of the post-test (9 min.) decreased considerably when compared to the pre-test response time (13 min.).

When the data belonging to F1's Counting Skills Test-1 and 2 are examined, it can be stated that computer assisted instruction given in the 1st and 4th sessions of counting skills developed F1's counting skills as well as increasing her speed.

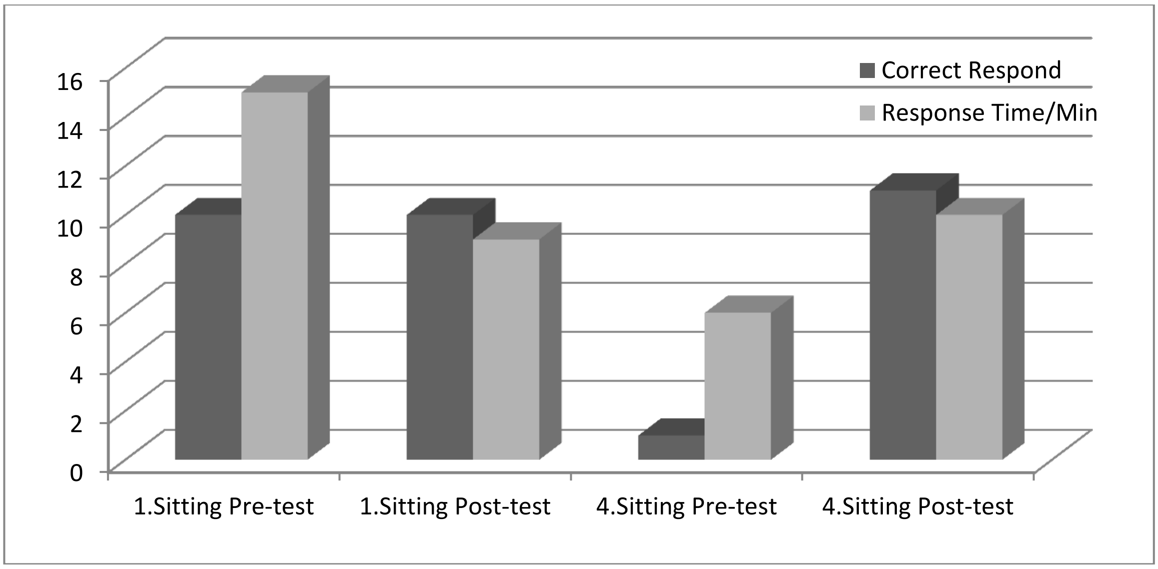

Figure 4. M1's counting skills data

Figure 4 presents M1's pre-test and post-test results of Counting Skills Test 1 -2 belonging to the 1^{st} and 4^{th} sessions of the individualized computer assisted instruction. When figure 4 is analysed, it is revealed that M1 answered total 10 questions correctly in the pre-test and post-test in Counting Skills Test-1. When the response time for the pre-test and post-test of Counting Skills Test- 1 is considered, it is found that there was a significant difference between the response times and the response time of the post-test (9 min.) decreased considerably when compared to the pre-test response time (15 min.).

When M1's pre-test and post-test data of Counting Skills Test-2 is examined within the context of the number of correct answers in Figure 4, it is found that he could answer only 1 item correctly out of 15 items in the pre-test and 11 items correctly in the post-test. When the response time is examined considering the number of the items he responded correctly (pre-test:6 min. and post-test: 10 min.), it is determined that M1's pace increased. When M1's data for Counting Skills Test 1 and 2 are analysed, computer assisted instruction used in the 1^{st} and 4^{th} sessions of counting skills developed M1's counting skills and also increased his speed.

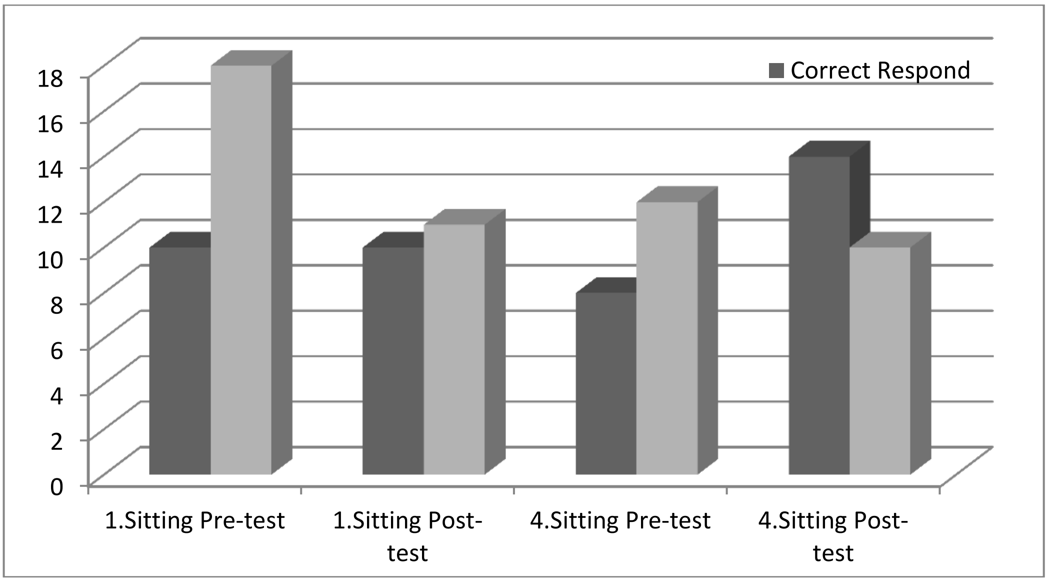

Figure 5. M2's counting skills data

Figure 5 demonstrates M2's pre-test and post-test results of Counting Skills Test 1 -2 belonging to the 1^{st} and 4^{th} sessions of the individualized computer assisted instruction. Examining Figure 5, it is found that M2 answered total 10 questions correctly in the pre-test and post-test in Counting Skills Test-1. When the response time for the pre-test and post-test of Counting Skills Test- 1 is considered, it is found that there was a significant difference between the response times and the response time of the post-test (11 min.) decreased considerably when compared to the pre-test response time (18 min.).

When M2's pre-test and post-test data of Counting Skills Test-2 is examined within the context of the number of correct answers in Figure 5, it is found that he could answer 8 items correctly out of 15 items in the pre-test and 10 items correctly in the post-test. When the response time is examined in terms of the number of the items he answered correctly, it is revealed that there was a significant difference between the response times and the post-test's response time (10 min.) decreased considerably when compared to the pre-test's response time (12 min). When M2's data for Counting Skills Test 1 and 2 are analyzed, it can be stated that computer assisted instruction used in the 1st and 4th sessions of counting skills developed M2's counting skills and increased his speed.

Findings Related to the Concept of Place Value

In this section, within the context of sub-problem "What are the effects of using computer on place value performance of students with mathematics learning difficulty?" the findings obtained from Place Value Test-1 and 2 were given. There are 17 items in Place Value Test-1 and 25 items Place Value Test-2. The findings of F1, M1, and M2 belonging to the concepts of place value were presented below in order.

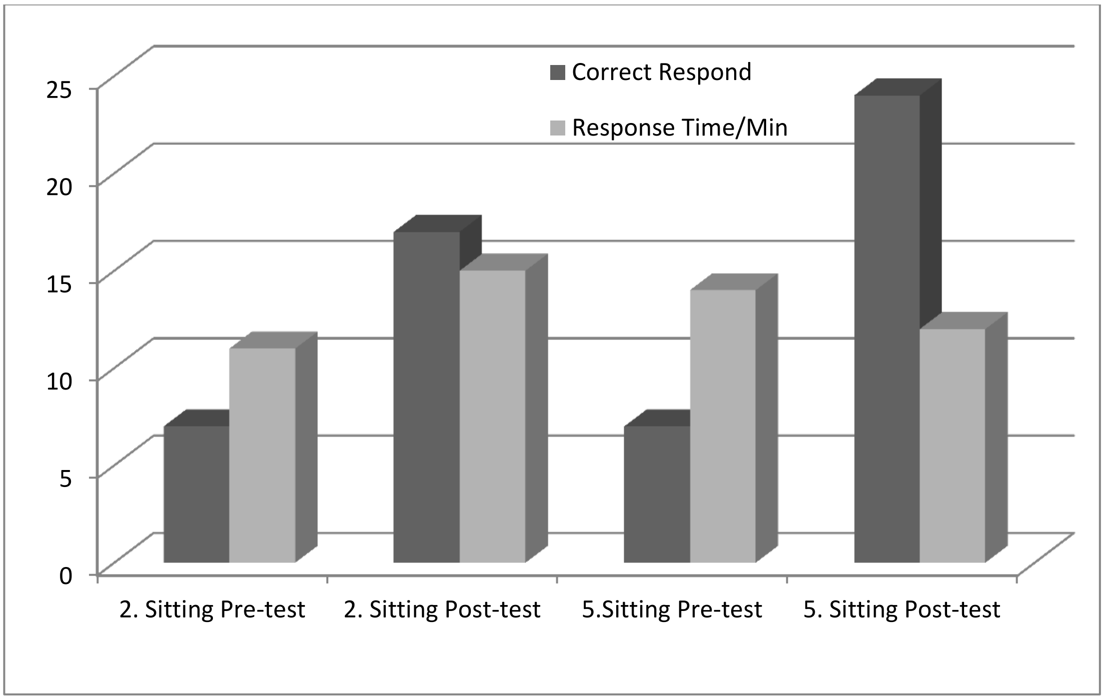

Figure 6. F1's test data belonging to place value

F1's pre-test and post-test results of Place Value Test 1 and 2 belonging to the 2nd and 5th sessions of the individualized computer assisted instruction are presented in Figure 11. When Figure 6 is examined, it is revealed that out of 17 questions, F1 could answer 7 questions in the pre-test and 17 questions correctly in Place Value Test-1. When the pre-test and post-test response time of Place Value Test-1 are examined considering the number of correct answers (response time for post-test: 11 min. and response time for the pre-test:15 min.), it can be stated that she increased her speed.

When F1's pre-test and post –test data in Place Value Test-2 are examined with regard to the correct responses in Figure 6, it is found that out of 25 items, she answered 7 items in the pre-test and 24 items in the post-test correctly. When the pre-test and post-post-test response times were examined considering the number of correct answers (post-test response time: 12 min. and pre-test response time: 14 min.) it can be stated that F1 increased her speed.

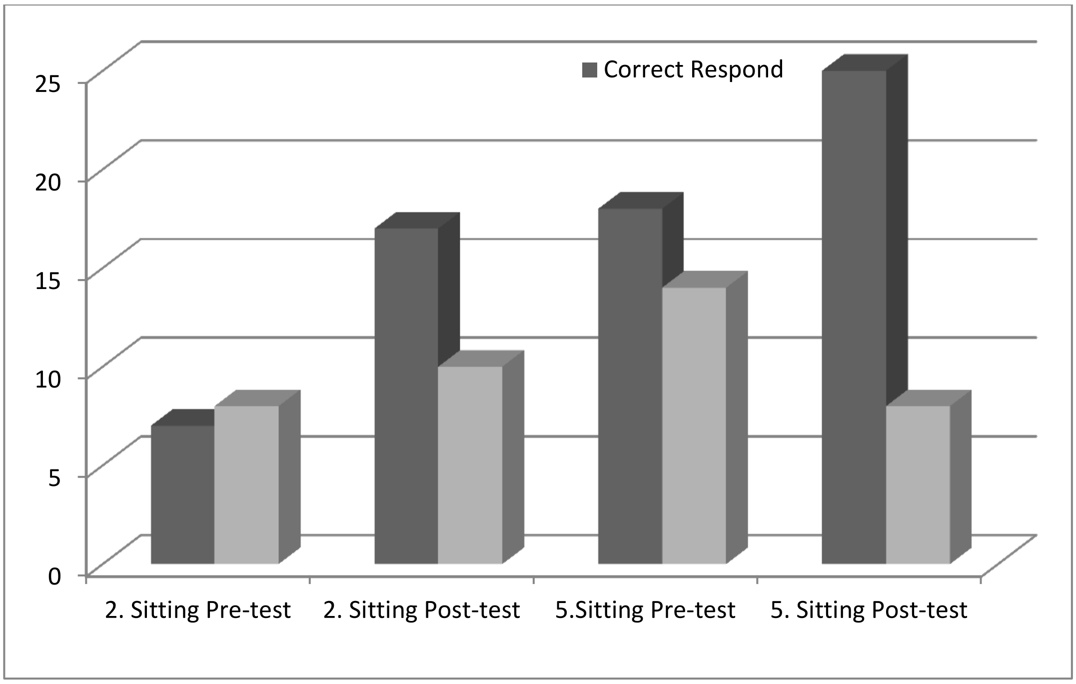

Figure 7. M1's test data belonging to place value concept

Figure 7 demonstrates M1's pre-test and post-test results of Place Value Test 1 -2 belonging to the 2nd and 5th sessions of the individualized computer assisted instruction. When Figure 7 is examined, it is revealed that out of 17 questions, F1 could answer 7 questions in the pre-test and 17 questions correctly in Place Value Test-1. When the pre-test and post-test response times of Place Value Test-1 are examined considering the number of correct answers (response time for post-test: 8 min. and response time for the pre-test:10 min.), it can be stated that M1 increased his speed.

When M1's pre-test and post –test data in Place Value Test-2 are examined with regard to correct responses in Figure 7, it is found that out of 25 items, he answered 18 items in the pre-test and 25 items in the post-test correctly. When the pre-test and post- test response times were examined considering the number of correct answers (post-test response time: 8 min. and pre-test response time: 14 min.) it can be stated that M1 increased his speed.

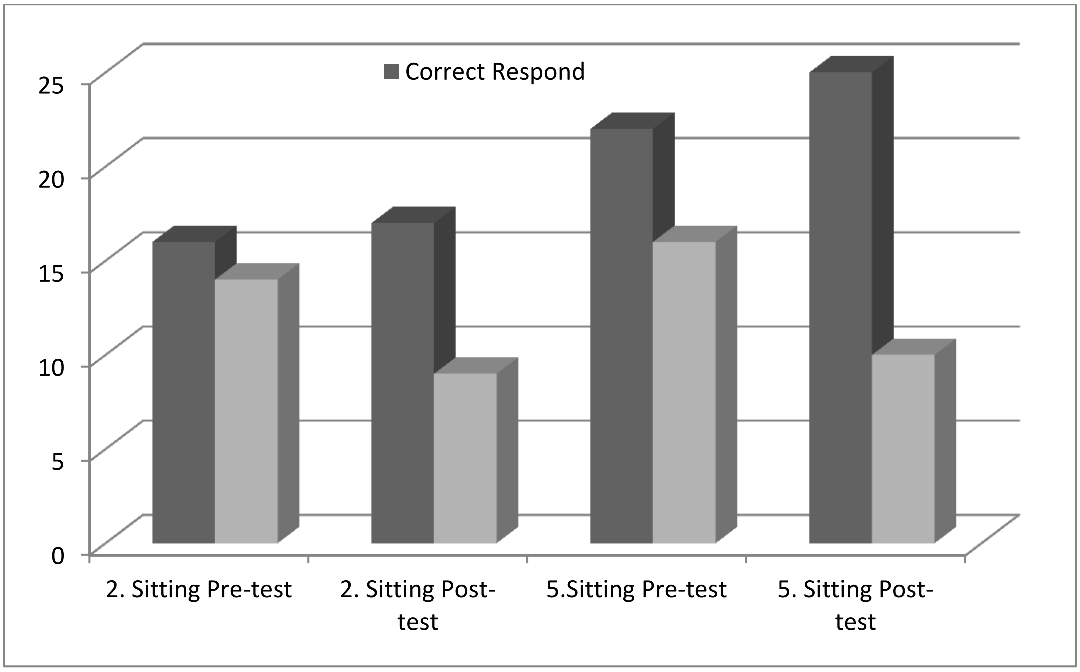

Figure 8. M2's test data belonging to place value concept

M2's pre-test and post-test results of place value Test 1 and 2 belonging to the 2nd and 5th sessions of the individualized computer assisted instruction are presented in Figure 8. When Figure 8 is examined, it is revealed that out of 17 questions, M2 could answer 16 questions in the pre-test and 17 questions correctly in Place Value Test-1. When the pre-test and post-test response times of place Value Test-1 are examined considering the number of correct answers (response time for post-test: 9 min. and response time for the pre-test:14 min.), it can be stated that M2 increased his speed considerably.

When M2's pre-test and post –test data in Place Value Test-2 are examined with regard to correct responses in Figure 8, it is found that out of 25 items, he answered 22 items in the pre-test and 25 items in the post-test correctly. When the pre-test and post- test response times were examined considering the number of correct answers in Place Value Test-2 (post-test response time: 10 min. and pre-test response time: 16 min.), it can be stated that M2 increased his speed considerably.

Findings Related to the Addition Performance of Students with MLD

In this section, within the context of sub-problem "What are the effects of using computer on addition performance of students with mathematics learning difficulty?" the findings obtained from Addition Test-1 and 2 were presented. Addition Test -1 consists of 21 items and Addition Test-2 consists of 25 items. The findings of F1, M1, and M2 belonging to the addition test were presented below in order.

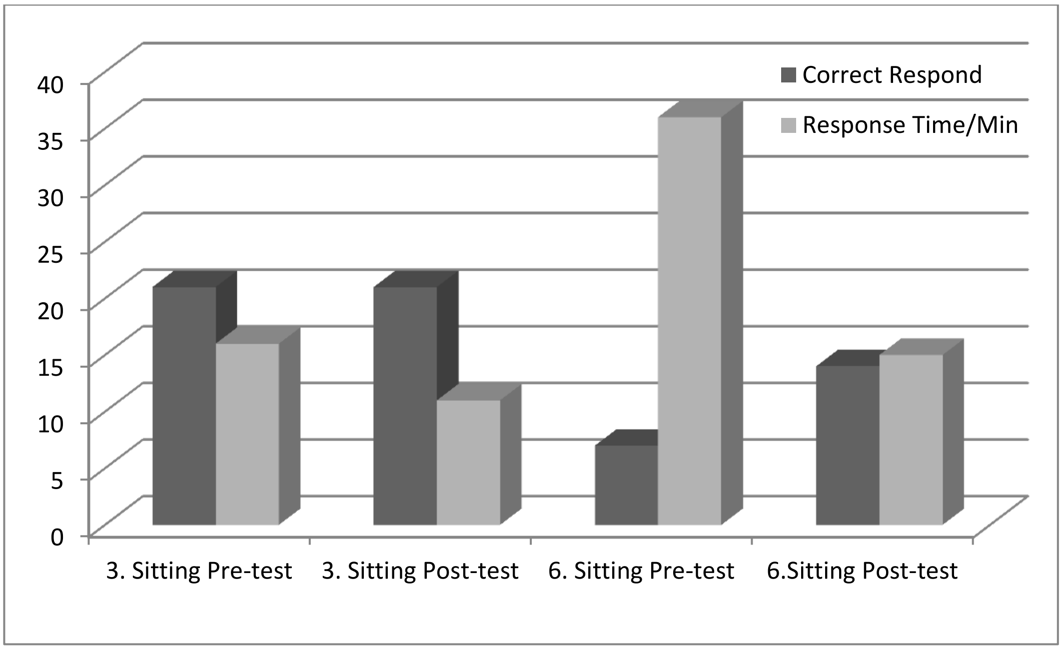

Figure 9. F1's addition test data

Figure 9 exhibits F1's pre-test and post-test results of addition test performance 1 and 2 belonging to the 3rd and 6th sessions of the individualized computer assisted instruction. When figure 9 is examined, it is found that out of total 21 questions in Addition Test-1 F1 answered total 21 questions correctly in the pre-test and post-test. When the response time for the pre-test and post-test of Addition Test- 1 is examined considering the number of correct responses (post-test response time: 11 min, pre-test response time:16 min), it is determined that F1 increased her response time.

When F1's pre-test and post –test data in Addition Test-1 are examined with regard to correct responses in Figure 9, it is found that out of 25 items, she answered 7 items in the pre-test and 14 items in the post-test correctly. When the pre-test and post- test response times were examined considering the number of correct answers in Addition Test-2 (post-test response time: 15 min. and pre-test response time: 36 min.) it can be stated that F1 increased her speed.

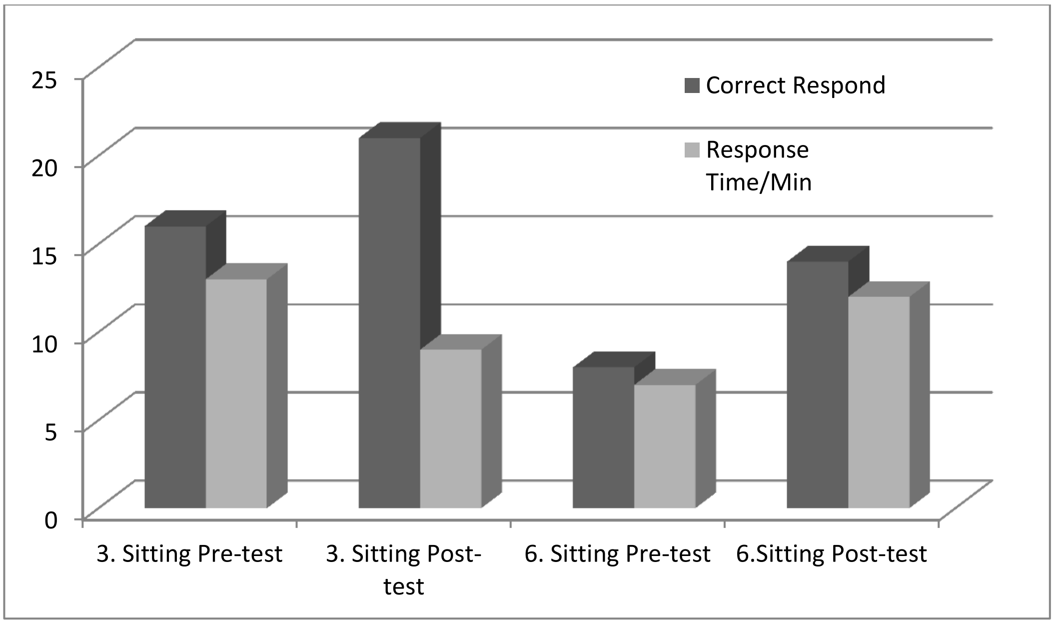

Figure 10. M1's addition test performance data

Figure 10 presents M1's pre-test and post-test results of addition test performance 1 and 2 belonging to the 3rd and 6th sessions of the individualized computer assisted instruction. When figure 10 is examined, it is found that out of total 21 questions in Addition Test-1 M1 answered 16 questions correctly in the pre-test and 21 questions in the post-test. When the response times for the pre-test and post-test of Addition Test- 1 is examined considering the number of correct responses (post-test response time: 9 min, pre-test response time:13 min), it is determined that M1 increased his response time.

When M1's pre-test and post –test data in Addition Test-1 are examined with regard to the correct responses in Figure 10, it is found that out of 25 items, he answered 8 test items in the pre-test and 14 items in the post-test correctly. When the pre-test and post-test response times are examined considering the number of correct answers in Addition Test-2 (post-test response time: 7 min. and pre-test response time: 14 min.) it can be stated that M1 increased his speed.

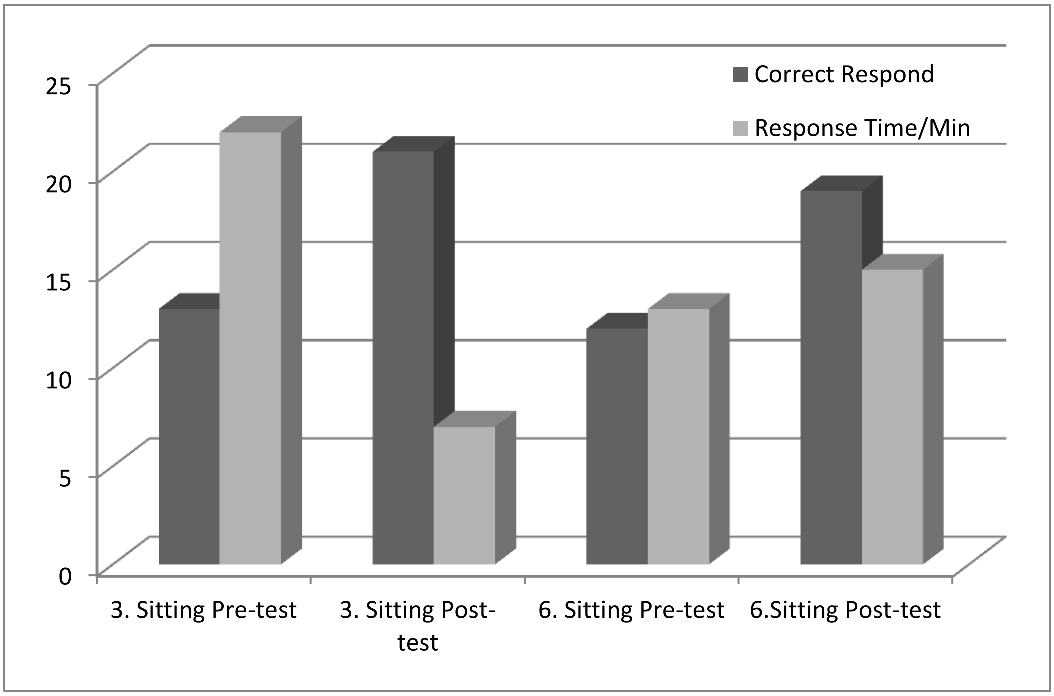

Figure 11. M2's addition test data

Figure 11 presents M2's pre-test and post-test results of addition test performance 1 and 2 belonging to the 3rd and 6th sessions of the individualized computer assisted instruction. When figure 11 is examined, it is found that out of total 21 questions in Addition Test-1 M2 answered 13 questions correctly in the pre-test and 21 questions in the post-test. When the response times for the pre-test and post-test of Addition Test- 1 are examined in terms of the number of correct responses (post-test response time:22 min, pre-test response time:7 min), it is determined that M2 increased his response time.

When M2's pre-test and post –test data in Addition Test-1 are examined with regard to correct responses in Figure 11, it is found that out of 25 items, he answered 12 test items in the pre-test and 19 items in the post-test correctly. When the pre-test and post-test response times are examined considering the number of correct answers (post-test response time: 13 min. and pre-test response time: 15 min.) in Addition Test-2, it can be stated that M1 increased his speed.

Conclusion and Discussion

The findings obtained from the study indicate that individual CAI had a positive effect on counting skills of students with MLD, they made progress in understanding the concepts of units and tens place values and the students could perform addition at the 1st grade level; however, the students still have difficulties when performing addition with regrouping (compose or decompose) at the 2nd grade level, especially when the numbers were given side by side. Moreover, the findings reveal that there was a considerable increase with students' problem solving speed.

Zerafa (2015) cites that students with MLD can make progress in comprehending basic numbers with suitable interventions. Mohd Syah and et al (2015) conducted a study and investigated the effects of a dyscalculia-oriented computer game developed using a remedial approach on 50 seven-year old Malaysian students' dyscalculia characteristics. When the experimental group was compared to the control group, they determined that the experimental group displayed a better performance (57.9%) and the students' problems like number disorientation and confusing arithmetic operations decreased considerably. Similarly, Amiripour, Bijan-zadeh, Pezeshki, and Najafi (2010) determined that assistive technology instruction increased dyscalculic students' capacity for solving mathematical problems and motivation. When the research studies carried out about students with MLD are examined, it is found that there are not direct studies conducted for place value concepts. In addition to this, Wilson and colleagues (2006) stated that CAI did not cause any progress in students' understanding of tens place value.

Beygi and colleagues (2010) remarked that after the training they gave, the addition and subtraction performance of students with MLD enhanced considerably. Moreover, Poobrasert and Gestubtim (2013) found that after the training they gave with the CAI materials they developed, students with MLD made progress in doing basic calculations and solving mathematical problems. Likewise, Fuchs and et al (2006) stated that the results pointed out that CAI promoted students' addition number combination skill but not subtraction number combination skill and the transfer to arithmetic story problems was not found.

In conclusion, as Scheid'in (2010) stated in his literature review, the results of many studies carried out about mathematics and learning difficulties reveal that computer-assisted instruction is successful; however, it reveals that the emergence of this effect will be possible with individualized curriculum for each student and teacher interaction. Within the framework of the findings obtained in the study, neuroscientific findings, especially triple coding must be considered while designing and developing activities for computer assisted instruction for the arithmetic skills development of students with MLD.

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