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Improving Basic Multiplication Fact Recall for Students with Mathematics Learning Disabilities

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Abstract

The purpose of this study was to investigate the effectiveness of the Fun Way program, and the Copy, Cover, and Compare (CCC) strategy on mastering the basic multiplication facts/times tables for students with MLD in Jordan. A total sample of 69 5th grade students participated in the study. This study presents a comparison study of three groups: the CCC strategy group, the Fun Way program group, and a control group that used the traditional way of teaching multiplication facts (Rote Memorization). The intervention was implemented for 12 weeks. The findings indicated that both Fun Way program and CCC strategy had better results compared to Rote Memorization on students' performances. In addition, students with MLD achieved the greatest increases in math multiplication performance when the Fun Way program was applied.

Keywords: Mathematics Learning Disabilities; Fun Way program; Copy, Cover, and Compare strategy; Rote Memorization; Special Education in Jordan.

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تحسين الحقائق الأساسية لتعلم جداول الضرب
لدى الطلبة ذوي صعوبات التعلم المحددة في الرياضيات

بشير أبو حمّور

ملخص

هدفت الدراسة الحالية للبحث في فعَّالية برنامج الطريقة الممتعة، واستراتيجية النسخ والتغطية والمقارنة (CCC) على إتقان حقائق جداول الضرب الأساسية مع الطلبة ذوي صعوبات التعلم المحددة في الرياضيات. وتكونت عينة الدراسة من 69 طالباً وطالبة في الصف الخامس الأساسي. حيث يقدم البحث الحالي دراسة مقارنة لثلاث مجموعات: مجموعة استراتيجية CCC، ومجموعة برنامج الطريقة الممتعة، والمجموعة الضابطة التي استخدمت الطريقة التقليدية لتدريس حقائق الضرب (الحفظ التلقيني). وتم تنفيذ برامج التدخل العلاجية السابقة لمدة 12 أسبوعًا، وقد أظهرت الدراسة أن كلاً من برنامج الطريقة الممتعة واستراتيجية CCC كان لهما نتائج أفضل على أداء الطلبة مقارنة بطريقة الحفظ التلقيني. بالإضافة إلى ذلك، أشارت النتائج إلى أن الطلبة ذوي صعوبات التعلم المحددة في الرياضيات قد حققوا التحسن الأفضل في أدائهم على حقائق الضرب عندما طُبقَ عليهم برنامج الطريقة الممتعة.

الكلمات الدالة: صعوبات التعلم المحددة في الرياضيات، برنامج الطريقة الممتعة، استراتيجية النسخ والتغطية والمقارنة، الحفظ التلقيني، التربية الخاصة في الأردن.

Approximately 10 % of all school-aged students have mathematics difficulties (MD; Berch & Mazzocco, 2007; Geary et al. 2007), and 5–7 % have mathematics learning disabilities (MLD; Geary, 2011). MLD is defined as a "… specific learning disability affecting the normal acquisition of arithmetic skills" (von Aster & Shalev, 2007). MLD, which is primarily a cognitive disorder, is considered a clinical diagnosis when a child's mathematics achievement is "substantially" below what would normally be expected, given the child's intelligence and educational opportunities (Mabbott & Bisanz, 2008). While problems in mathematics can be predicted as early as age 4 or 5 (Geary, Hamson, & Hoard, 2000), a full math disability may be clearly diagnosed by third grade (Fuchs et al. 2009). In most cases, MLD can include difficulties with spatial orientation, sequencing, and abstract concepts such as time and direction. In some individuals, a math disability may be linked to a concomitant reading disability, but in others math disabilities are more closely related to problems of working memory and problem solving (Swanson, Jerman, & Zheng, 2008).

Students with MLD often struggle with early number concepts that are foundational to the acquisition of more advanced mathematics (Aunola, Leskinen, Lerkkanen, & Nurmi, 2004; Geary, 2011; Jordan, Kaplan, Ramineni, & Locuniak, 2009; National Mathematics Advisory Panel [NMAP], 2008). For example, students with learning disabilities may experience persistent deficits in the performance of skills related to number combinations (Geary 2011; Gersten et al. 2009), which negatively affects the acquisition of the skills needed to solve whole number computations and word problems (Fuchs et al. 2005). Because proficiency in multiplication is a prerequisite for instruction in rational numbers (e.g., fractions, ratios, and proportions) and pre-algebra (Woodward, 2006), mastery of this foundational skill is fundamental. However, without effective intervention, chronically low scores on mathematics assessments suggest that many students with MLD will continue to display poor mathematical achievement across time (National Assessment of Education Progress [NAEP], 2013).

Mathematics is a subject that students with MLD will encounter throughout their academic and daily life experiences. Special education teachers have reported that two out of every three students with disabilities experience mathematics problems (Riccomini & Witzel, 2010). Carpenter (1985) found that special education classrooms devote as much as one third

of available instructional time to the remediation of mathematics deficiencies. However, even with a substantial portion of their academic time devoted to mathematics, students with MLD experience persistent problems related to learning and applying mathematics. They usually perform basic addition facts only as well as third graders without disabilities, show growth patterns in mathematics of only 1 year for every 2 or more years of school, demonstrate proficiency levels equivalent to only fifth or sixth grade, demonstrate difficulties with word problem–solving skills, and show limited proficiency on tests of minimum competency (Mayrowetz, 2009).

Before a student can master difficult mathematical concepts, it is important to be able to solve basic mathematical problems. Multiplication facts are a fundamental part of the primary math curriculum. It has been shown through research that students with learning disabilities often use counting strategies (e.g., finger counting and touch math) to solve basic mathematical problems (Ozaki, Williams, & McLaughlin, 1996). Students with MLD frequently find multiplication tasks to be a stumbling block in their mathematical progress. Many use inefficient and inaccurate counting methods and encounter difficulties in memorizing times tables (Geary, 2004; Kilpatrick, Swafford, & Findell, 2001). In mathematics education today, the emphasis is on developing children's understanding through exploration and discovery (Elkins, 2002; van Kraayenoord & Elkins, 2004). Use of concrete materials, pictures, diagrams, and discussion increases students' familiarity with the process of multiplication and assists in their observation of regularities and patterns. For example, to learn the basic multiplication facts contained within the 0 to 9 times tables, over 100 multiplication combinations need to be mastered. Understanding commutativity–that the order of the two numbers does not affect their product (e.g., 7 x 5 = 5 x 7) – reduces the combinations by about half. Understanding the principles of multiplication by zero, by one and by two (which is the same as doubling the number), further reduces the number of combinations to learn to a manageable 28 (Kilpatrick et al., 2001; Swan & Sparrow, 2000).

Cognitive Abilities and Multiplication Facts

Memorizing and understanding basic multiplication facts is essential to a student's continued growth in math. Proper training and repetitive practice must occur to ensure a student's success in building fluency and automaticity with math facts. According to Baroody, Bajwa and Eiland (2009), instant recall of basic math facts involves learning the facts in a constructive and meaningful manner. They concluded one should be able to make connections between the math expression and its response. In fact, Caron (2007) affirmed that when automaticity is developed with math facts, it frees up working memory, allowing students to perform more advanced problem solving tasks. The researcher further stated that students need to have a deeper knowledge and comprehension of the multiplication process so they can determine when, where, and how to utilize the facts. Baroody et al. (2009) supported Caron's claim that memorizing basic facts is imperative for future success with advanced math courses. Students are not taught basic math facts and are not given the opportunity to practice repeatedly over a long period of time; therefore, they may face obstacles when it comes to building fluency and automaticity. Caron (2009) acknowledged that students who fail to memorize basic math facts for several years may begin to avoid the task altogether. Over time, this may cause students to develop an anxiety towards the math concept, which could negatively affect and decrease their working memory (Ashcroft & Kirk, 2001). Woodward (2006) also suggested that students might experience a cognitive overload if they are not able to mentally retrieve multiplication facts quickly and accurately. Both Baroody et al. (2009) and Caron (2007) concluded that fluency and memorization of math facts are developed through meaningful long-term engagements with number sense.

Once accuracy is well established, the use of an explicit timing component can increase accuracy and can ultimately facilitate production of automatic responses (Rhymer, Henington, Skinner, & Looby, 1999). In developing fluency and automaticity, accuracy must be adequately developed before automaticity becomes the goal (Kelley, 2008). Crawford (2009) defined automaticity as the ability to quickly and accurately answer basic math facts without consciously thinking about them. According to Crawford (2009) students need continued practice to develop fluency, which over time leads to an achievement of automaticity. The researcher suggested as well that multiplication facts become a priority to memorize starting at

the fourth grade level because knowledge of basic multiplication facts are needed to solve other math problems such as fractions, division, and multiple digit multiplication. Woodward (2006) also indicated that automaticity with math facts is important to mathematical success and achievement over time.

Prior to engaging students in any program for improving the recall of basic multiplication facts, their current level of proficiency needs to be established. Levels of proficiency can be identified by giving students a pre-test of their mathematics facts (usually written), and asking students to complete as many questions as they can in a set amount of time (e.g., 2 minutes) (Abu-Hamour & Mattar, 2013). Proficiency is then scored as the number of questions answered correctly on the pre-test. When answers are predominantly recalled from memory, the student should be able to answer approximately 40 basic mathematics questions correctly in one minute (Howell & Nolet, 2000). To measure the effectiveness of the program, a test similar to the pre-test can be administered at the completion of the program, and in the follow-up stage.

Intervention Strategies and Programs

Rote learning is a memorization technique based on repetition. The idea is that one will be able to quickly recall the meaning of the material the more one repeats it. In the research review on basic fact intervention for students who were identified with MLD, many involved rote memorization of basic facts (Christensen & Gerber, 1990; Okolo, 1992). These earlier works overwhelmingly supported the use of extensive practice as an approach to promoting improvement in retrieval of basic facts. However, the positive intervention effects have been limited to addition facts only and not multiplication facts (Powell, Fuchs, Fuchs, Cirino, & Fletcher, 2009). Unfortunately, recent practice in Jordan document that practitioners are still widely used rote memorization to teach students with MLD multiplication facts. Memorizing numbers is not only difficult, but sometimes impossible for students with MLD in Jordan. Unfortunately, in most cases, no amount of drill and practice will achieve the desired results. Some of the alternatives to rote learning include meaningful learning, associative learning, and active learning (Abu-Hamour & Al Hmouz, 2014).

Teachers need to implement instruction that ensures high rates of active student engagement, high levels of success to promote mastery, and immediate feedback for correct and incorrect responses (Keel, Dangel, & Owens, 1999). Furthermore, researchers (e.g., Steel & Funnell, 2001) believe that the development of multiplication recall is in part related to the frequency with which problems and opportunities for repeated practice are provided. However, it is not simply repetition that leads to improved performance. The structure of the practice needs to overcome plateaus in performance (Ericsson, Krampe, & Tesch-Romer, 1993). Studies (e.g., Harrison & Van Dervender, 1992; Kroesbergen & Van Luit, 2003; Williams, 2000; Wilson & Robinson, 1997) have shown that multiplication programs aimed at improving the recall of basic multiplication facts have been successful with students of varying skill levels.

There are, however, a number of research-based approaches to build math multiplication fact fluency in struggling learners. They include Copy, Cover, and Compare (CCC) (Skinner, McLaughlin, & Logan, 1997), Picture-Story Method (Liautaud & Rodriguez, 2013), and many other interventions (e.g., Racetracks: Beveridge, Weber, Derby, & McLaughlin, 2005; Flash Cards: Skarr et al, 2014). Because more research has focused on Racetracks and Flash Cards methods for teaching multiplication facts, this study placed a greater emphasis on Picture-Story Method and CCC Strategy.

Picture-Story Method

In this approach a story or language based method is facilitated in teaching multiplication facts for students who previously had difficulty with the memorization of those facts. In this line of research, the Fun Way program (Liautaud & Rodriguez, 2013) for teaching times tables was identified during review of the available literature. This program was developed based on a picture-story method. It was structured based on the concept that "using a picture and story to illustrate the number characters gives students a visual clue". Once the stories are learned, students associate the numbers with the story which triggers the answer to the fact. According to the program's manual, a study involving 756 students, 18 schools, and 36 teachers showed that post-test scores were significantly higher for the times tables-the Fun Way group. Each school was assigned an experimental third grade class in which students learned the multiplication facts with the aid of the pictures and stories presented in the program. At the same time, the

control class learned the facts conventionally with repetition and timed tests. The pre-test scores of both groups were not significantly different, however, the post-test scores were up to 24% higher in the picture and story group. Also noteworthy was the degree of change or improvement from pre-test to post-test score. Results showed up to 59% more improvement with the times tables the Fun Way program. Similar promising findings were documented when using the curriculum Memorize in Minutes by Alan Walker (Walker, 2000) in teaching fourth-grade students the multiplication facts (3s through 9s) over a period of 22 sessions of 30 minutes each (Mahler, 2011).

Copy, Cover, and Compare Strategy

CCC strategy requires the student to look at the fact, write the fact while saying each part aloud or silently, cover the fact, write it again from memory, and finally compare the written fact to see if it was written correctly. If the math fact was incorrect, an error correction procedure and error drill is typically implemented (Bley & Thornton, 2001; McLaughlin & Skinner, 1996; Skinner et al., 1997). This procedure allows the student to self-tutor and engage in error correction in a very straight forward and simple manner. CCC strategy has been implemented with a large number of children and across a wide range of academic behavior (McLaughlin, Weber, & Barretto, 2004). The efficacy for spelling has been impressive (Abu-Hamour, 2013; Hubbert, Weber, & McLaughlin, 2000), and mathematics (Bley & Thornton, 2001; Skinner, Bamberg, Smith, & Powell, 1993; Stading, Williams, & McLaughlin, 1995).

Significance and Context of the Study

In the absence of intensive instruction and intervention, students with MLD and difficulties lag significantly behind their peers (Abu-Hamour, 2017; Abu-Hamour & Mattar, 2013; Jitendra et al., 2013; Sayeski & Paulsen, 2010). Conservative international estimates indicate that 25% of students struggle with mathematics knowledge and application skills in general education classrooms, indicating the presence of mathematics difficulty (Mazzocco, 2007). Additionally, 5% to 8% of all school age students have such significant deficits that impact their ability to solve

computation and/or application problems that they require special education services (Geary, 2004). Similarly, recent research in Jordan indicates that 23.5% of students were identified as having MD (Abu-Hamour & Al Hmouz, 2016). This finding suggests that the prevalence rate for MD is close to the rates also found in English-speaking Western countries. Furthermore, researchers in Jordan have stated in numerous reports and articles that the Jordanian educational system is in need of effective strategies and programs to provide students with MD with an appropriate intervention (Abu-Hamour, 2013; Abu-Hamour & Al Hmouz, 2014; Abu-Hamour & Mattar, 2013). Unfortunately, researchers' observation indicates that teachers of students with MD in Jordan are still using rote memorization method as a sole method to teach multiplication facts.

Regrettably, if basic multiplication facts are not acquired during the primary school years, it is highly unlikely they will be practiced in a structured manner in secondary school (Steel & Funnell, 2001). Basic fact retrieval remains one of the most important components in the primary-level mathematics curriculum because it is foundational for development of subsequent mathematics skills; lacking fluency in basic computation can place students at risk of further mathematics difficulties (National Mathematics Advisory Panel, 2008). Children should master all 100 multiplication facts (0-9 times 0-9) by the end of third grade or early fourth grade (Polya, 2002). If children fail to obtain mastery of these facts, they will likely have difficulty with more complex math skills, which could result in cumulative failure. Students' failure to meet math benchmarks for their respective grade levels is a continuing cause of great concern of parents, teachers, and school policy makers (Stein, Kinder, Silbert, & Carnine, 2006).

Given the difficulties experienced by many students with MLD in Jordan, and the lack of effective strategies and methods to teach them; it is a necessity to incorporate instructional practices that are both effective and efficient for helping these students in Arab countries. The Fun Way Program and the CCC strategy that have been used in English speaking countries effectively, should be investigated for Arabic speaking countries. To the best of the author's knowledge, no studies had investigated the use of the Fun Way program or CCC strategy in teaching multiplication facts in Jordan previously.

Study Purposes

The purpose of this study was to evaluate the effectiveness of the Fun Way Program and CCC strategy on mastering the basic multiplication facts for 5th grade students with MLD. On the other hand, students in the control group used the traditional way of math instruction, which relies heavily on the rote memorization of teaching basic multiplication facts. Two main hypotheses were examined. First, there will be a significant difference in terms of the performance on math multiplication achievement test between students who used the Fun Way Program or CCC strategy compared to students who just remained in the traditional way of math instruction (rote memorization). Second, to be a truly useful strategy or program, the facts learned had to be retained after the completion of the intervention. Therefore, this study examined whether or not the change in multiplication recall endures over time.

Method

This study uses a quasi-experimental, pre-test/post-test design as shown in Figure 1. Groups were randomly assigned to the instructional approaches: Group 1) Rote memorization, Group 2) CCC strategy, and Group 3) Fun Way program.

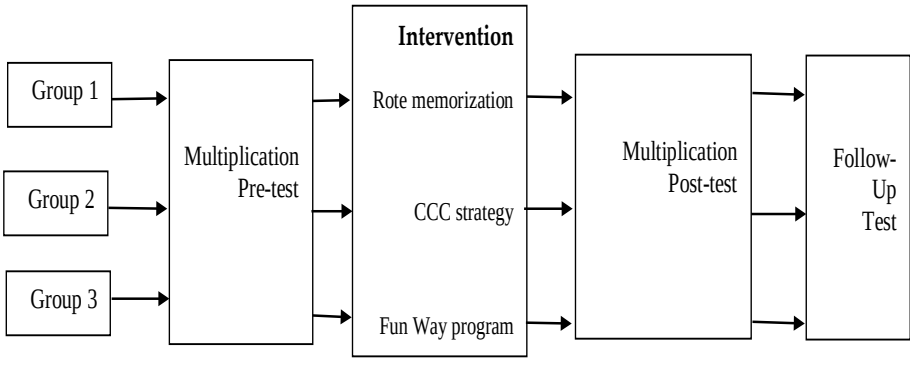

Figure 1. Research design incorporating pre-test, intervention, post-test, and follow-up test.

Participants

A total convenient sample of 69 fifth-grade students with MLD participated in the study. Of the total sample, 39 were male and 30 female. These students were enrolled in 2016/2017 academic year. Participants were drawn from two private coeducational primary schools at Amman-Jordan. These schools accepted to collaborate with the researcher of this article for the sake of getting the results of this research and use the most effective program with their students. The Rote Memorization group consisted of 23 students (12 male and 11 female) with an age range of 125-137 months (averaging 129.47 months). The CCC strategy instruction group consisted of 23 students (14 male and 9 female) with an age range of 124-138 months (averaging 128.48 months). The Fun Way program group consisted of 23 students (13 male and 10 female) with an age range of 125-137 months (averaging 128.69 months).

Across the two schools, curricular goals and objectives, materials and reading instruction methods were similar (e.g., Arabic numeral are used for teaching math). Students participated in a 40-minute multiplication lessons three times a week for approximately three months. For the purpose of this study, students who struggle with math were identified and nominated by their teachers to be participants in this study. Then, the study author diagnosis all participants using the Arabic Version of Woodcock-Johnson Tests (Schrank, Mather, & McGrew, 2014) to make eligibility decisions. In addition, for the purpose of this study, a math GPA of 66 and below was used as a cutoff point to include students with MLD in the study, and the pretest assessments supported the nominations.

After controlling gender and age, all participants were selected randomly to the groups and consent forms were sent to parents seeking their permission for participation. Parents who agreed to let their children participate in the study were requested to complete a short questionnaire that addressed the inclusion criteria of this study. The participants were selected from a larger set of students (285) who were assessed to meet the requirements for inclusion in the study: intelligence within the average range, native speakers of Arabic and fluency in English, and no sensory impairments. Two special education teachers (these teachers have a degree in special education and diploma in learning disabilities), both with instructional experience and trained in the intervention methodology, worked closely with the author to implement the intervention programs to

the participants. To be included in the final data analysis, participants were required to attend at least 30 of the 36 scheduled practice sessions, complete all the tests, and have written parental consent.

Test Instrument

Basic multiplication fact recall was measured by the number of multiplication facts answered correctly in a multiplication test completed in six minutes. The multiplication pre-test contained 48 horizontally presented multiplication questions randomly chosen from the 0 to 9 times tables. The post-test and follow-up test were generated by randomly re-ordering the questions used in the pre-test.

Procedures

Students in the control condition (group one) used the traditional way of teaching multiplication in Jordan, which relies heavily on training the memory by repeating practice. Students in the second group received CCC strategy instruction. Students in the third group received Fun Way program. Students in the three conditions completed one pretest session, a post-tests session, three days after the training ended, and a follow up test that was conducted approximately three weeks after the completion of the program. The time between pre-test and post-test was 12 weeks for each of the groups.

Direct Fact Multiplication Instructions

The following interventions were provided during the study:

The Times Tables the Fun Way Program/the picture-story method. This method was adapted from the work of Liautaud and Rodriguez (2013). This method was built on the fact that using a picture and story to illustrate the number characters gives students a visual clue. Once the stories are learned, students associate the numbers with the story which triggers the answer to the multiplication facts. In this method, students are learning the stories by using the following steps: a) stimulate interest in the story by discussing the

story line before it is read. Ask students questions that are pertinent to the story. When the story is finally introduced, students will be more likely to remember the story because it will fit into something that they have discussed and experienced; b) tell the story to the students while they look at the picture in the text. Or, if working one-on-one, read the story together and then spend some time talking about the picture. This reinforces the story-number connection; c) ask a student to read the story out loud in the text; d) ask another student to read the caption located underneath the picture; e) write the fact on the board or a piece of paper and remind the students to look at the numbers of the fact and remember the story. Point out the similarities. For example: "Don't these two eights look like snowmen? And remember how cold they are and that the sticks are for the fire. 'Sticks are for' sounds like 64."; e) ask the students to tell the story in their own words; and f) use additional learning activities (e.g., students make their own book with the story illustrations and the facts).

Copy, cover, and compare. Each session, the students were given a CCC sheet, which contained 10 multiplication facts and was allowed to complete the sheet. After completing the CCC sheet (McLaughlin & Skinner, 1996; Stading et al., 1996), the students were given a probe sheet of 48 problems and timed for six minutes by the teacher. The teacher recorded the corrects and errors made by the student during the timing. After each probe sheet was completed, the student would briefly review any errors with the teacher and plan what math materials she needed to complete in the next class day. The child also received praise for increased performance and for working hard.

Treatment integrity and Reliabilities. Treatment integrity checklists were used to measure the extent to which the teachers implemented the intervention correctly. These checklists were based on the critical components of the selected intervention. Each step on the checklist was scored as *completed* or *not completed*, and the percentage of steps completed accurately was determined. A total of 50% of the 36 teaching sessions were randomly selected to examine the fidelity of the intervention. While the teacher implemented the intervention, an observer independently and simultaneously conducted treatment integrity assessments. The average interobserver reliability was 99% (range 98–100%). In addition, the team of this study had weekly updates and discussions to address the crucial points in the delivery of the intervention and provide feedback. To ensure

consistency of testing administration across the different phases of the study, the researcher and the teachers read from scripts and used timers. The researcher scored all tests twice and entered the data into an Excel spreadsheet. In terms of data entry reliability, all of the Excel data (100%) were checked against the paper scores and all discrepancies were resolved by examining the original protocols. In order to respond to the research questions, all data were entered into the Statistical Package for the Social Sciences (SPSS). In terms of statistical analyses, descriptive statistics and one-way independent Analysis of Variance (ANOVA) were used to investigate the study's hypotheses.

Results

Descriptive statistics of the study test scores are reported in Table 1 for the three groups of the study. These scores represent both pre- and post-intervention, and follow-up phases. The descriptive results indicated that the achievement of the Fun Way and CCC groups were greater than that of the control group (Rote Memorization) by the end of the intervention and in the follow-up phase. The visual representation of Table 1 is presented in Figure 2 as well.

Table (1) ***Means and standard deviations of the study test across the three phases.***

	Group 1		**Group 2**		**Group 3**	
	M	SD	M	SD	M	SD
Pre-Intervention	9.22	3.52	8.43	3.92	8.91	4.03
Post-Intervention	11.83	3.14	22.65	7.05	31.57	6.33
Follow-Up	10.30	3.49	21.26	7.10	30.91	5.58

Note. n= 23 for each group, Group 1= Rote Memorization (Traditional), Group 2= CCC strategy, Group 3= Fun Way, M= Mean, SD= Standard Deviation.

Groups' Comparisons

The study Test was administered to the students in the beginning of the study to determine their math multiplication skills. Although students in the three groups had varied means (M) and standard deviations (SD) on the Multiplication Test (in the Rote Memorization group, M = 9.22, SD = 3.52; for CCC group, M = 8.43, SD = 3.92; for Fun Way group, M = 8.91, SD = 4.03), ANOVAs applied to Multiplication Test scores indicated that before intervention, scores for the three groups were comparable, F (2, 66) = .24. $p > .05$.

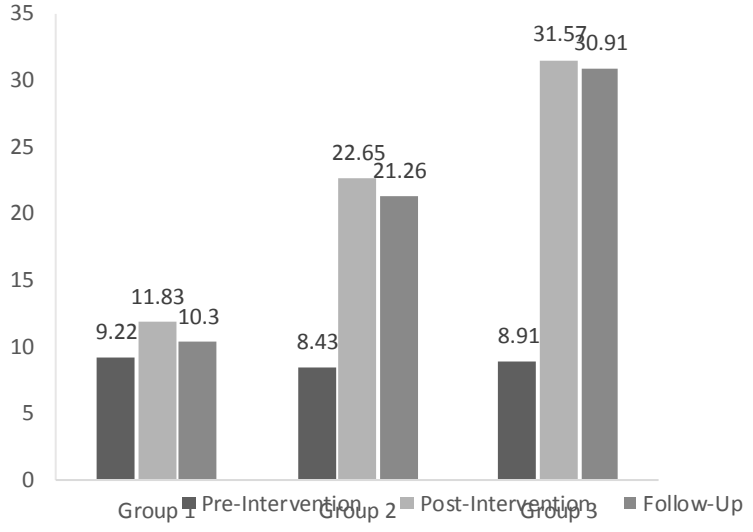

Figure (2) ***Mean performance on the study Test for the three groups across the three phases.***

To explore the group differences after applying the intervention, two planned comparisons were performed: one to test whether the control group was different to the two experimental groups, and one to investigate whether there were differences between the two experimental groups. All assumptions of performing one-way independent ANOVA were examined. No violations of normality and homogeneity of variance were detected. The variances were equal for the experimental groups and control group, $F(2,$

66) = 8.47, $p > .05$. Planned contrasts revealed that using the Fun Way program or the CCC strategy significantly increased the multiplication achievement compared to just using the traditional way (Rote Memorization) of teaching multiplication to students with MLD, $t(66) = -10.37$, $p < .05$ (2-tailed), and that using the Fun Way program significantly increased multiplication achievement compared to using the CCC strategy, $t(66) = -5.24$, $p < .05$ (2-tailed). In addition, there was a significant linear trend, $F(2, 66) = 67.54$, $p < .001$, indicating that students who received the Fun Way program did better than students who received CCC strategy.

Social Validity|:

Evaluations of social validity focus on the satisfaction with the intervention's outcomes by those who use the intervention. The participants completed a four-item questionnaire in a yes/no format following the completion of the study. Specifically, the students were asked if they felt their multiplication skills improved during the intervention program. The researcher read to the participants each item on the student questionnaire and asked them to color in a happy face for ''yes'' or a frowning face for ''no.'' Results indicated that students involved in this study were satisfied with the tutoring procedures and assessment process. Approximately, 97% of the students believed that their multiplication skills improved because of the intervention programs. The teachers indicated that they liked the experience of teaching math multiplication and their students had increased their multiplication skills by the end of the intervention.

Discussion:

Not long ago, mathematics research was far behind reading research in terms of volume of research and quality of studies (Bryant et al. 2008). Over the past 10 years, however, progress has been made in studying the prevention and intervention of early mathematics failure (e.g., Abu-Hamour & Mattar, 2013; Bryant et al. 2008; Jordan et al. 2009). Research has demonstrated the effectiveness of systematic, explicit mathematics instruction (Fuchs et al. 2005; Gersten et al. 2009), and strategic instruction in mathematics (Woodward, 2006). As discussed earlier in the study, students with MLD in Jordan frequently find multiplication tasks to be a stumbling block in their mathematical progress. Many use inefficient and

inaccurate counting methods and encounter difficulties in memorizing tables by using rote memorization technique based which based on repetition.

The main purpose of this study was to investigate the effectiveness of the Fun Way Program, and the CCC strategy on mastering the basic multiplication facts for 5th grade students with MLD in Jordan. The results indicated that there were significant differences in terms of the performance on math Multiplication Test between students who used the Fun Way Program or CCC strategy compared to students who just remained in the traditional way of math instruction (Rote Memorization). Furthermore, the results indicated that students with MLD achieved the greatest increases in math multiplication performance when the Fun Way program was applied. In other words, students who received the Fun Way program did better than students who just used CCC strategy. The previous findings were confirmed in the follow up phase as well. The following sections of this discussion address: (a) the effects of using stories and visualized teaching in students' math multiplication achievement; (b) the use of CCC strategy in teaching students with MLD multiplication facts; and (c) the limitations, future research, and implications for this study.

The effect of using stories and visualized teaching in students' math multiplication achievement. Finding of this study indicated that the use of picture-story method was positively associated with students' with MLD achievement on the math Multiplication Test. It seems that this method release working memory capacity for students with MLD which allow them to tackle math multiplication facts more easily. This finding concurs with previous work showing that students with MLD exhibit improvements in their math multiplication skills when stories and visualized approach was used in teaching (Skarr et al. 2014; Liautaud & Rodriguez, 2013; Walker, 2000). Research has highlighted the importance of visual representations for both teachers and students in their teaching and learning of mathematics. The use of multiple representations in general is an important part of teachers' knowledge of mathematics and they can play an important role in the explanation of mathematical ideas. Also, external representations can highlight specific aspects of a mathematical concept (e.g. the array representation illustrating the commutative and distributive nature of multiplication), therefore supporting this process of explanation (Ainsworth, 1999). In addition, the ability to draw on multiple representations is an important aspect of students' mathematical understanding (Greeno & Hall,

1997). Visual representations enable students to make connections between their own experience and mathematical concepts, and therefore gain insight into these abstract mathematical ideas (Flevares & Perry, 2001).

The effect of using CCC strategy in students' with MLD math multiplication achievement. The results of this study indicate the effectiveness of the CCC strategy in improving students with MLD math multiplication skills. The CCC procedure improved correct rate and decreased errors. These findings replicate the work of other researchers in math facts (Ozaki et al., 1996; Skinner et al., 1997; Stading et al., 1995). CCC procedure allows the student to self-tutor and engage in error correction in a very straight forward and simple manner. Furthermore, CCC has been implemented with a large number of children and across a wide range of academic behavior (McLaughlin et al., 2004; Skinner et al., 1997). Fortunately, in spite of students with MLD working memory deficit, they can be taught specific strategies (e.g., CCC strategy) that may improve their math performance.

Limitations, Future Research, and Recommendations

This study has limitations that should be considered. First, data were only collected from fifth-grade students with MLD; consequently, the generalizability of the findings to other grades is unknown. Second, the sample size was relatively small and came from private schools. In Jordan, the upper and upper middle class to a much greater extent send their children to private schools than families with lower income. In spite of educational reforms in the public school sector, private schools are still perceived better than public education. Thus, a replication of the study with a larger sample from public schools and across different grades would strengthen the conclusions.

Furthermore, researchers should conduct similar studies that investigate other math facts (e.g., addition, subtraction, and division) using the picture-story method and or CCC strategy. Another factor to consider is that a written test may fail to be a good indicator of multiplication recall as poor performance can be attributed to the variances in students with MLD reading and writing skills that required for answering the Multiplication Test. Further studies may overcome the reading/writing issues through the

use of a verbal test, where questions are read aloud and verbal responses are given by the students. However, this may need to be completed on an individual basis and it was not possible to administer a verbal test in this study due to time constraints.

Students with MLD typically demonstrate difficulties learning arithmetic combinations such as multiplication, which is a necessary skill for more advanced mathematics such as algebra. Teachers must spend time using effective instructional approaches that improve student performance. Researchers should investigate new ways of teaching multiplication facts in the Arab world. Both picture-story method and CCC strategy were socially valid, low-cost, efficient, and easy-to-use ways to improve students' multiplication skills. Teachers cannot simply ask students with MLD to memorize multiplication facts. Rote memorization had previously been unsuccessful in solving basic multiplication facts with students with MLD due to their memory deficit. Thus, it is time to investigate and implement new instructions (e.g., picture-story method and CCC strategy) that ensure high rates of active student engagement, effective use of multisensory and procedural approach in learning, high levels of success to promote mastery, and immediate feedback for correct and incorrect responses.

Finally, it is worth documenting that according to Jordanian Law (*20 in 2017*) (The Higher Council for the Affairs of Persons with Disabilities, 2017), students with MLD must participate and progress in the general education curriculum, and the expansion of inclusive educational programs for these students in Jordan, has resulted in a growing body of research examining strategies for supporting student math learning in general education classes. As the focus of teaching has shifted toward a more child centered approach, there is much discussion about how to differentiate both teaching and curriculum to suit the needs of different learners. This is even more pronounced when considering the teaching of students with MLD within the context of inclusive classrooms.

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