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EFFECTIVENESS OF THE DIRECT INSTRUCTION METHOD IMPLEMENTATIONS IN TEACHING FRACTIONS TO STUDENTS WITH MENTAL DEFICIENCIES

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Abstract:
This study, which investigates the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies, utilized a multiple-case design, one of the single-subject research methods. The study involved three students who were diagnosed with a mental deficiency, who had the prerequisite skills, and who did not have basic fraction skills. The study was conducted in individual rooms allocated to the students in the institutions they attended. Data were collected through the data collection tool including 16 behaviors concerning the basic fraction skills. The findings obtained from the study showed that the direct instruction method was effective in teaching basic fraction skills to students with mental deficiencies. In line with this result, teachers who teach students with mental deficiencies could be recommended to use the direct instruction method implementations in teaching fractions.

Keywords: mental deficiencies, special education, mathematics instruction, fractions, direct instruction implementations

1. Introduction

The basic goal in education processes is to help individuals gain independent life skills that will help them to adapt to their environment. In line with this goal, education services provided to individuals with mental deficiencies also aim to transform them into

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independent and productive individuals (Gürsel 2017). Individuals who have mental deficiencies are instructed self-care, daily-life, and social skills as well as academic skills with a view to realizing these goals (Kot, Sönmez, & Yıkmış, 2017). These skills, which are called functional academic skills, are defined as the necessary skills required by students to gain skills enabling them to live and work in society independently (Çifçi Tekinarslan, 2017). These skills support the skills for independent participation in the social environment where students live (Özak & Diken, 2010). Students' success in the programs carried out in their educational institutions and development of independent life skills are closely associated with their academic skills acquisition and generalization levels. Mathematics is one of the skills areas among functional academic skills (Yıkmış, Çiftçi Tekinarslan, & Sazak Pınar, 2005). Mathematics is defined as an academic discipline that involves problems and solutions about numbers or quantity (Altun, 2005), the science of design and order (Olkun & Toluk Uçar, 2014). Mathematics teaches many skills such as prediction, communication, mental processes, and problem-solving (Baykul, 2016). In addition, its use in professional skills and daily life fields has been increasing every day (Yıkmış, 2012). The success of students with mental deficiencies in mathematics skills is closely associated with the quality of the instruction services provided to them. These individuals with differences in the mental processes need to actively use the mathematics skills they have acquired in their daily life by generalizing them (Çıkılı, 2008). These skills contribute to the strength of these different children in coping with the problems they face (Stultz, 2013).

During the instruction to students with mental deficiencies, it is important to consider that mathematics skills are the prerequisites of each other (Dağseven Emecen, 2008). For instance, acquisition of the concepts about fractions before the processes will have positive contributions to learning (Jordan, Resnick, Rodrigues, Hansen, & Dyson, 2017). Disadvantaged students are known to experience deficiencies in the acquisition of mathematics skills in some areas such as memory, strategy use, communication, reading-writing, motivation, applying the rules, and meanings of the concepts (Ewing, 2011). The reasons for these problems could be reviewed under the content organization, student characteristics, teaching methods, and teaching materials titles (Carnine, Jitendra, & Silbert, 1997). In other words, some difficulties experienced by the students with mental deficiencies in the acquisition of mathematics skills do not mean that they will not be able to learn. When the necessary revisions are made, they can also acquire mathematics skills (Gürsel, 2017). Use of concrete experiences in the instruction of mathematics skills to students with mental deficiencies, instruction of the skills by dividing them into little steps, and revisions and exercises in line with students' needs are reported to help prevent the difficulties they face (Sazak Pınar, 2013).

Studies show that when the necessary instructional revisions about mathematics learning process were made, students with mental deficiencies usually acquired the mathematics skill instructed (Eliçin, Dağseven Emecen, & Yıkmış, 2013; Kelly, Gersten, & Carnine, 1990; Stein, Carnine, & Dixon, 1998).

Studies show that individuals who demonstrated differences in mental functions were administered errorless teaching methods (Wolery, Werts, Synder, & Caldwell, 1994; Yüksel Öğüt & Yıkmış, 2013), touch math (Eliçin, Dağseven Emecen, & Yıkmış, 2013; Simon & Hanrahan, 2004), interaction unit (Yıkmış, 2016), and direct instruction implementations (Dağseven, 2001) in the instruction of functional academic skills. Although the direct instruction implementations are teacher-centered, they require intensive student interaction. The interaction process involves four stages that include motivation, modeling, guided practices, and independent practices (Kinder & Carnine, 1991). Each stage enables a gradual teacher-student interaction and all behaviors expected in the learning process are expected to be fulfilled by the students (Ewing, 2011; Kinder and Carnine, 1991; Stein, Carnine, Dixon, 1998). Study results show that direct instruction implementations are effective in the acquisition of functional academic skills among students with mental deficiencies (Çelik, 2007; Dağseven Emecen, 2008; Ekergil, 2000; Flores & Kaylor, 2007).

Given that the need for mathematics increases every day, mathematics skills have gained a lot of importance in education systems. In this regard, the frequent use of fractions in the numbers learning domain in daily life makes the instruction of these skills to students with mental deficiencies necessary (Carnine, Jitendra, and Silbert, 1997). Despite the high number of studies on the instruction of four operations, geometry, hours, and money to students with mental deficiencies, there is a quite limited number of studies on the instruction of fractions to students with mental deficiencies in our country (Tongal, 2010). Therefore, this study aims to investigate the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies.

The purpose of this study is to identify the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies.

2. Method

This study, which aims to investigate the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies, utilized a multiple-case design. Effectiveness studies that utilize a multiple-case design, one of the single-subject research methods, investigate the effect of one independent variable on one dependent variable with at least three subjects. Various organizations are made in the environment to enhance experimental control. The judgment about the effectiveness of the study is arrived by comparing the data collected at the beginning of the study and the data collected in the middle and at the end of the study in the monitoring phase. The graphical analysis method is utilized to perform this analysis. The collected data are processed and interpreted on the graph (Tekin İftar 2012).

2.1. Study Group

The sample was selected by identifying the students diagnosed with mental deficiencies by contacting teachers, psychological counselors, and administrators at school. The students who were identified were administered the Prerequisite Skills Checklist. After the Prerequisite Skills Checklist was administered, students who had the skills of answering the questions, counting out rhythmically, reading numbers, writing the numbers when told, demonstrating whole, half, and quarters among the shapes were identified. Then among these students, five students who failed to show the fraction of the image given, read the fraction shown, write the fraction of the image shown, or recognize the numerator-denumerator and the division line were selected. Pseudo-names were used for the selected students.

The first student, Betül, female, was born in 2004, attended full-time inclusive education in high school, could follow four-stage instructions, answer questions with five-word sentences, count out rhythmically, read the numbers written, and write the numbers read.

The second student, Murat, male, was born in 2009 and benefitted from part-time inclusive education in primary school. He was included in full-time inclusive education in pre-school. He could follow three-stage instructions and expressed himself using four-word sentences. He could count out rhythmically, could read the numbers written and write the numbers read. When the concepts of whole, half, and quarter were asked, he could answer each 5/5 correctly.

Third student, Okan, male, was born in 1999. He attended school in a vocational special education center. He had been involved in full-time inclusive education in all the schools he attended before. He did not benefit from pre-school education. He could express himself with five-word sentences, he could follow four-stage instructions, he could count out rhythmically, write the numbers read and read the numbers written. When the concepts of whole, half, and quarter were asked, he could answer 5/5 correctly.

The fourth student, Ayşe, female, was born in 1998 and attended a special education vocational school. She could follow four-stage instructions, respond questions with five-word sentences, count out rhythmically, read the numbers written and write the numbers read. When the concepts of whole, half, and quarter were asked, she could answer 5/5 correctly. The study was piloted with Ayşe.

The fifth student, Mehmet, male, attended part-time inclusive education in secondary school, could follow three-stage instructions, answer questions with four-word sentences, count up rhythmically, read the numbers written and write the numbers read.

2.2. Reliability

All the implementations were video-recorded to enhance the reliability of the study. These records were reviewed by the observer; the form included “+” and “-“ options. When the practitioner reacts correctly in the instruction, “+ was marked”, but when she reacts incorrect or no reacts, “-“ was marked. Reliability calculations for the

implementations utilized practitioner number of correct responses / previously planned practitioner number of correct responses x 100 formula (Erbaş, 2012). In line with the formula, reliability findings were 100% for the starting phase, monitoring phase, and daily evaluation phase and 98% for the practice phase.

The study also involved the reliability data between the observers. Reliability data obtained from the practitioners and observers were obtained using the number of observers' agreements/number of agreements between the observers + number of disagreements x 100 (Erbaş, 2012). Reliability findings between the observers were 100% for the daily evaluation phase and monitoring phase, and 98% for the reliability between the observers.

2.3. Setting

The implementations were performed in the environments allocated for the procedures by the school administration in the schools where the participating students were enrolled. The environment had a table, chairs, and the materials used during the instruction; the room was lit and heated appropriately.

2.4. Pilot Practice

The individualized instructional plan about basic fractions skills prepared by the researcher was piloted with one student. In this process, instruction implementations were performed by the researcher, who also planned how to transfer the plan to practice. At the end of the three pilot implementations, it was found that the instruction plan was applicable by the researcher.

2.5. İmplementations

The instructional plan prepared based on the direct instruction method was administered to three students in the environments identified before. Initially, three students' beginning level data were obtained. Then beginning level data belonging to Betül were also obtained, and instruction was started when stability was realized in the beginning level data. When Betül's instruction was completed and data stability was realized, Murat's beginning level data were collected. When data stability was realized and instruction was completed, Okan's beginning level data were collected. When Okan's beginning level data demonstrated stability, instruction sessions were started. When Okan's instruction sessions were completed and data showed stability, instruction sessions were completed. Stability data were collected on the 7^{th}, 14^{th}, and 21^{st} days after the instruction sessions were completed. The instruction sessions were performed on Monday, Tuesday, Wednesday, Thursday, and Friday, with two sessions each day.

2.6. Data Collection Tools

This study, which investigates the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies, collected data through the Prerequisite Skills Checklist, the Criterion-referenced Measurement Tool,

Teacher Interview Form and Family Interview Form. The Prerequisite Skills Checklist is composed of eight items. This tool was administered to the students individually.

The Criterion-referenced Measurement Tool was composed of 16 behaviors. Instructions and materials were prepared for each item and applied individually. When the student gave a correct response to the instruction, "+ was marked", but when s/he gave incorrect response or no response, "-" was marked.

Table 1: The Criterion-referenced Measurement Tool Behaviors

Behaviors
1. divides a shape given into two equal pieces.
2. divides a shape into four equal pieces.
3. makes a whole with two equal pieces given.
4. makes a whole with four equal pieces given.
5. makes a half with the pieces given.
6. counts how many pieces a given shape has.
7. reads the fraction shown.
8. shows the fraction appropriate to the shape given.
9. shows a shape appropriate to the fraction given.
10. shows the division line as a fraction when asked.
11. tells that the line shown is a division line.
12. writes the fraction appropriate to the shape given.
13. shows the denominator when asked.
14. tells that what is shown is the denominator.
15. shows the nominator when asked.
16. tells that what is shown is a nominator.

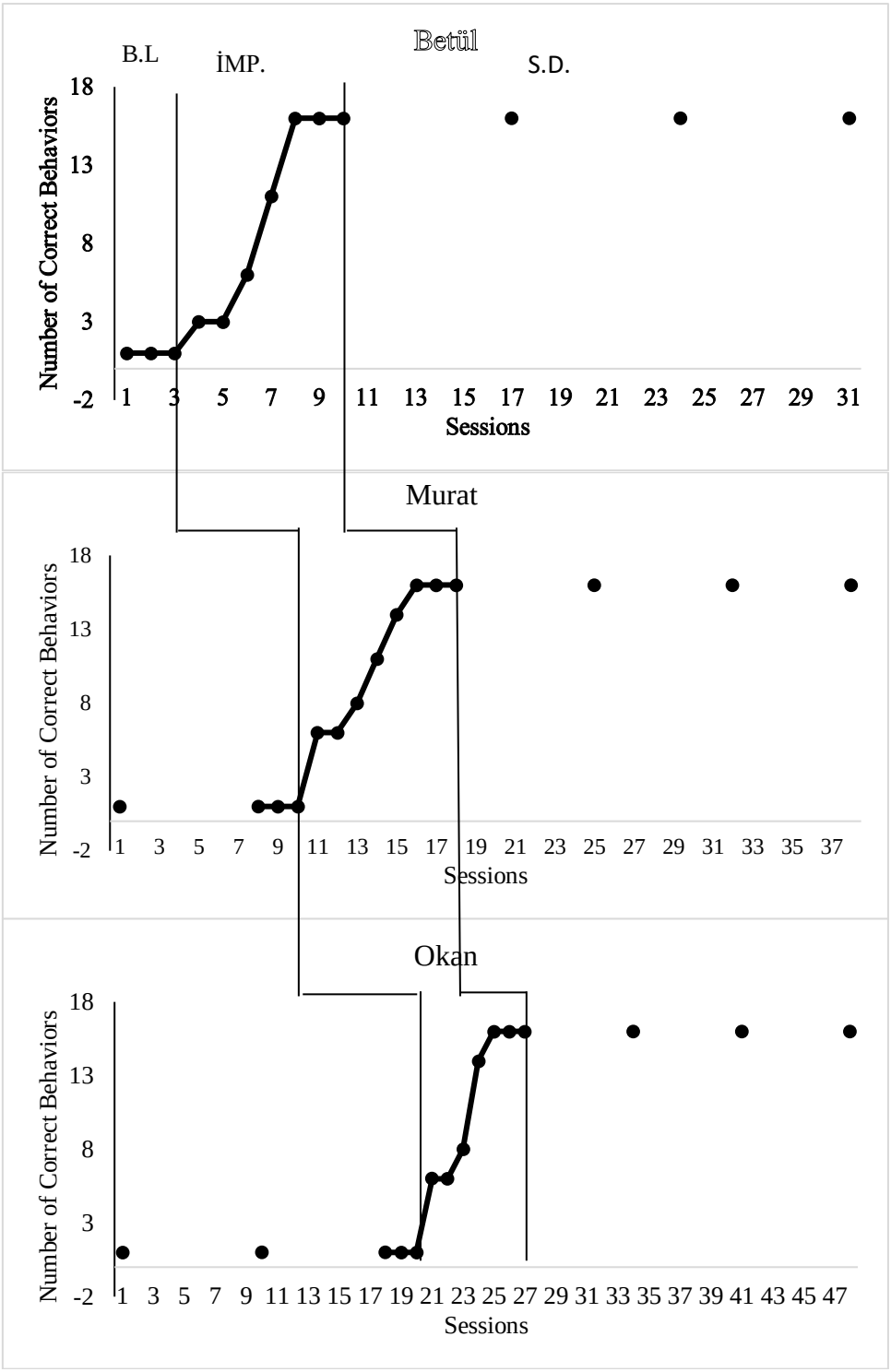
After the instruction process was completed, interviews were conducted with the families for social reliability purposes. Previously prepared interview forms were utilized during the interviews. The family interview form included four questions, and the interviews were performed individually. The interview questions were asked, and the answers were recorded by the practitioner. The teacher interview form included six questions. These forms were filled by the teachers themselves.

2.7. Data Analysis

The graphical analysis method was utilized for data analysis. This method enables to demonstrate the data obtained through the data collection tools in single-subject studies in one graph. In addition, as all the data starting from the beginning level to the monitoring level were recorded in this graph, the effect of the independent variable on the dependent variable is interpreted through the changes happening in the trend line. In effectiveness studies, if a positive increase is observed between the data collected at the beginning and in the end, it can be concluded that the independent variable had effects on the dependent variable (Tekin İftar 2012).

3. Findings

Graph 1 shows the effectiveness findings based on the data obtained through the data collection tools in this study, which aims to investigate the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies.



Graph 1: The graph on the basic fraction skills belonging to Betül, Murat, and Okan

As Graph 1 shows, Betül's beginning level data were found as 1. This student could independently perform the sub-goal of counting the pieces of the shape shown, which was among the 16 sub-goals indicated in the Criterion-referenced Measurement Tool. Seven instruction sessions were conducted with Betül. In the first two sessions, she responded to three behaviors correctly. She was found to have six correct responses in the 4th session and sixteen correct responses at the end of the 5th session, which demonstrated that she performed the behaviors at a 100% level. When the student came to the phase of forming a whole using four equal pieces, she needed some clues. The practitioner went back to the guided practices phase and repeated the activity.

As Graph 1 demonstrates, Murat's beginning level data were found as 1. At this stage, the student was found to independently realize the sub-goal of counting the pieces of the shape shown, which was among the 16 sub-goals. Eight instruction sessions were performed with Murat. In two instruction sessions done with this student, he was also able to perform the six sub-skills independently. The student needed clues in the skill of reading the fraction in the Criterion-referenced Measurement Tool. The practitioner returned to the guided practice stage and repeated the instruction implementations. The student completed eight skills at the end of the third session, 14 skills at the end of the fourth session, and 16 sessions at the end of the sixth session independently at a level of 100%.

Graph 1 shows that Okan's beginning data were found 11. This student could independently perform the skill of counting the pieces of a shape given, which was among the 16 sub-goals in the Criterion-referenced Measurement Tool. Okan performed six sub-goals in the first two sessions, eight in the third session, 14 in the fourth session, and 16 in the fifth session independently at a level of 100%. Totally seven sessions were conducted with the student. In the second session, Okan needed clues in the reading the fraction given skill. The practitioner repeated the practices by returning to the guided practices phase.

Based on these data, it could be concluded that the direct instruction method was effective in teaching basic fraction skills to all the three participating students.

Parents and teachers of the students who were administered the sessions were interviewed to identify the social reliability level of the study. The questions in the social reliability forms administered to the parents were read by the practitioner, and the answers given by the parents were recorded by the practitioner. The interview results showed that all the parents of the participating students thought that basic fraction skills could contribute to their children's academic skills and they would use this skill in daily life. They also reported that the implementations enabled their children to develop positive attitudes towards the mathematics course. They also stated that similar studies should be conducted. The interviews conducted with the teachers revealed that the teachers thought that these skills of students would increase their academic skills and make their daily life easier. Besides, they mentioned that the practices increased students' motivation level and participation. Finally, they reportedly wanted these kinds of studies

to be done again. In this regard, the parents and teachers reportedly found the instruction of these skills functional.

4. Conclusion and Discussion

This study, which aimed to investigate the effectiveness of the direct instruction method implementations in teaching fractions to students with mental deficiencies, was conducted with three students. The results showed that the direct instruction method implementations were effective in teaching basic fraction skills to students with mental deficiencies. Stein, Carnine, and Dixon (1998) stated that direct instruction method implementations enabled a systematic and rapid learning process. The effectiveness findings of the study showed that all the students learned quickly. Therefore, the results of the present study are in line with this information. Study results on the effectiveness of the individualized direct instruction method implementations (Çelik, 2007; Dağseven, 2001; Ekergil, 2000; Flores and Kaylor, 2007; Kelly, Gersten and Carnine, 1990; Sazak Pınar, 2013; Kot, 2014) demonstrated their effectiveness. The presence of the studies on the effectiveness of different methods and techniques on the instruction of functional academic skills to students with mental deficiencies (Eliçin, Dağseven Emecen and Yıkmış, 2013; Simon and Hanrahan, 2004; Wolery, Werts, Synder, & Caldwell, 1994; Yüksel Öğüt & Yıkmış, 2013; Yıkmış 2016) does not mean that the direct instruction method is not effective. The result indicating that direct instruction method implementations were effective in teaching basic fraction skills to students with mental deficiencies is in line with the other study results. Based on the data obtained in this study, it is recommended that teachers should utilize the direct instruction method for students with mental deficiencies and similar implementations could be used for the other fraction skills or with other student groups.

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