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Teaching Puzzle-Solving Skills to Students with Multiple Disabilities via a Tablet Computer *

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Abstract

The aim of this study was to teach the puzzle-solving skills to students with multiple disabilities by using a tablet computer and enable them to demonstrate this skill fluently afterwards. The research was conducted in two phases. In the first phase, the effectiveness of direct instruction in teaching puzzle-solving skills to students with multiple disabilities by using a tablet computer was investigated. Also, generalization effect of the acquired skills on various materials and their maintenance effect after 1, 3 and 4 weeks were evaluated. In this phase of the study, multiple probe design with probe trials across subjects, one of the single-subject research designs, was used. In the second phase, it was aimed to increase the fluency of those students in puzzle-solving on a tablet computer. Similar to the first phase, a single-subject design, the changing criterion model was used in the second phase. Three participants, two male and one female, were involved in the study. All sessions were held as one-to-one instruction arrangements. The study revealed that direct instruction was effective in teaching puzzle-solving skills, the participants demonstrated the target skills at the end of weeks 1, 3 and 4. In addition, it was observed that they could generalize those skills to different materials, settings and people, and they improved their fluency.

Keywords

Multiple disabilities
Tablet computer
Puzzle
Direct instruction

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Introduction

Time is defined as a duration for which any planned action took place or will take place. Individuals should spend their time properly through careful planning. As there is no way to go back in time, it is irretrievable; therefore, inefficient use of time leads to stress among people (Hazar, 2009). Time can be divided into two categories as the time spent during sleep and the time spent awake. The latter can be further divided into two as work time and leisure time. The work time includes any action and movement of an individual producing anything (Aytaç, 2002) while the remaining time off the work includes the leisure time. Leisure time, on the other hand, can be defined as a time period in which an individual participates in activities that support his or her personal development without any coercion after fulfilling his/her tasks and responsibilities and has a good time (Hacıoğlu, Gökdeniz, & Dinç, 2009).

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Although leisure-time activities are classified under different categories, they all have an important role in not only raising awareness of duty and responsibility among individuals with disabilities, encouraging them, and giving them the opportunity to work in an orderly manner but also enabling them to become fully integrated into the society, and thus, changing the negative attitudes of the society (Bergin, 1992). In addition, these games prepare all children with and/or without disabilities for life (MEGEP, 2008), increase their life quality, reinforce their social interaction, foster their independence in their living spaces, boost their self-confidence and enable them to actively participate in life (Dollar, Fredrick, Alberto, & Luke, 2012). Therefore, the leisure-time activities play a key role in the lives, development and education of the individuals with disabilities. These activities are essential for not only individuals with a single disability, but also for those with multiple disabilities. Leisure-time activities can also be planned and implemented in accordance with developmental characteristics, interests and needs of individuals with multiple disabilities (Hanley, Cammilleri, Tiger, & Ingvarsson, 2007).

Leisure time is very important not only for individuals with normal development but also for those with abnormal development, especially for the ones who have disabilities. Individuals with disabilities have a great deal of leisure time; however, they cannot usually use this time in a fruitful way, so leisure-time education is essential for them. Unfortunately, teaching leisure time activities and skills to those individuals is given low priority (Miller, 2014).

Leisure-time education can help such individuals to acquire and develop skills necessary for a lifetime, develop themselves, have fun and rest (Aydemir, Bozkurt, & Şekerci, 2015; Dündar & Karaca, 2011; Schleien, Meyer, Heyne, & Biel Brandt, 1995). While leisure-time education has an important place within the system of renewed and developing education, its continuity in the lives of individuals with disabilities is very essential (Ayar, 2009). Furthermore, it affects formal education both directly and indirectly because it can also be given at schools which prepare them for life (Tezcan, 1994). Therefore, it should be planned considering those individuals' features to produce a positive effect on their lives (Sivan & Ruskin, 2000).

It takes place as free time activities in programs implemented in pre-school and special education institutions. These activities consist of interest corners, art activities and games. Interest corners consist of play family, science and nature related items and activities, books, puppets, musical instruments and educational toys, whereas art activities consist of kneading tools and items, paper ornament, painting activities and crafting activities with recyclable materials (MEGEP, 2008). Leisure-time activities are categorized as indoor-outdoor, active-passive, mental and physical in the literature. It is also classified as indoor activities (listening to music, reading books, watching TV), social activities (sightseeing, eating out, having fun with friends), cultural activities (going to the cinema, going to the theatre, going to a concert), sports activities (hiking, playing basketball), and outdoor activities (picnicking, sightseeing, etc.) (Obinna, Owei, Ayodele, & Okwakpam, 2009).

Leisure time activities consist of various activities and games under different categories that enable individuals have joy, rest and entertain. Games are of great importance in terms of development, behavior and socialization of individuals with disabilities as well as those with normal development. While playing games, they not only develop mentally and physically but also learn to socialize (MEGEP, 2007). One of these games is jigsaw puzzle. The purpose of this study was to teach puzzle-solving skills to participants and enable them to achieve fluency in solving puzzles. Since they include a wide range of games and activities, it is possible to find an activity suitable for any individual's preferences, characteristics and interests. One of these activities is puzzle-solving. It is an ancient game which allows individuals of all ages to enjoy their free time while driving their brains into thinking. Besides being fun

and educational, it is considered to be a very useful game since it relieves stress. Furthermore, puzzle makes a great contribution to mental development of individuals. First of all, children learn to recognize their environment thanks to solving puzzles. Furthermore, holding and examining puzzle pieces can help children improve their eye-hand coordination, gross and fine motor skills (Aral, Gürsoy, Can Yaşar ve Şimşek, 2015), problem solving skills, shape recognition skills and goal-setting skills (www.puzzleteacher.com).

It is very difficult for students with disabilities, especially those with multiple disabilities, to demonstrate the ability to solve puzzles without any instruction, which is a skill that individuals with normal development can gain without any help from others. Therefore, systematic instruction is required to enable those individuals to acquire and generalize the skills. Skills and games can be taught to such students through direct teaching, errorless teaching, or natural teaching method (Eldeniz Çetin, 2016). In this research, direct teaching method was adopted. The direct teaching method consists of four steps; (a) creating necessity awareness: making students pay attention to a skill and realize when and why they may need it; (b) modeling: explaining the target skill to the students and showing them how to apply it; (c) guided practices: making students do practices with clues that are gradually withdrawn under teacher guidance; (d) independent practices: placing the whole responsibility on students (Dağseven-Emecen, 2008). In this study, the direct teaching method was applied by taking these four steps into consideration.

When the literature is analyzed, it is seen that researches are carried out to gain leisure time skills for individuals with developmental disabilities. Considering these studies, different techniques of leisure time activities are used for different disability groups without any assistive technology (Aral at al., 2015; Babayemi & Akinsola, 2014); Using the errorless instruction methods (Cannella-Malone et al., 2016; Chan, Lambdin, Laarhoven, & Johnson, 2013; Collins, Hall, & Branson, 1997; Çay & Eldeniz Çetin, 2018; Eldeniz Çetin & Çay, 2016; Jerome, Frantino, & Sturmey, 2007; Wall, Gast, & Royston, 1999); It can be seen that it is gained by using assistive technology (Chan, 2013).

In the literature, multiple disability is given under the category of severe disability, while some studies name it severe and multiple disability. It is possible to encounter research on teaching leisure time skills to students with severe and multiple disabilities. For instance, Dutt (2010) studied teaching toy selection skills to individuals with severe and multiple disabilities; Holburn, Nguyen, and Vietze (2004) studied the use of a micro-switch to change photographs in a PowerPoint presentation with five adults with severe physical and mental disabilities; Kemp, Stephenson, Cooper, and Hodge (2016) researched teaching the skill of using iPads and books with pictures to three preschool children with severe and multiple disabilities; Lancioni et al. (2010) did research on teaching the skill of using a television to an adult with multiple disabilities; Schleien, Kiernan, and Wehman (1981) taught to play dart with systematic instruction to three adults with severe and multiple disabilities. When the studies conducted are examined, more research and applications are needed to enable students with multiple disabilities to use their leisure time effectively. Therefore, this study aims to teach leisure time skills to students with multiple disabilities.

Assistive technology is used to gain target skills and ensure the permanence of these skills to individuals with special needs (Borg, Lindstrom, & Larsson, 2009; Fok, Polgar, Shaw, & Jutai, 2011; Pettersson & Fahlstrom, 2010; Reed & Bowser, 2005). It provides benefits in terms of providing motivation facilitating learning, increasing self-confidence and individualization to individual with special needs. It is possible to come across research using a tablet computer in teaching skills to individuals with disabilities in special education environments. Acungil (2014) examined the effectiveness of a tablet computer curriculum in teaching individuals with mild to moderate intellectual

disability the ability to use a tablet computer. Bahçalı (2016) examined the effectiveness of teaching the ability to conduct job interviews with the video model presented to individuals with developmental disabilities with a tablet computer. Eliçin (2015) examined the effectiveness of the program offered via a tablet computer in providing functional reading skills to children with autism spectrum disorders.

It is considered important for individuals with disabilities teaching of leisure time skills to acquire social skills, spend their time effectively and productively, and spend quality time with their families and peers. That is, the review of the available literature reveals that various studies have been conducted on teaching leisure-time activities to individuals with severe and multiple disabilities. However, no research on teaching puzzle-solving skills to students with multiple disabilities through a tablet computer and ensuring the fluency of the taught skill, which is an intensively used item in our daily lives, was encountered; therefore, a study on it was thought to be necessary considering the significance of spending leisure time in an effective and high-quality way for students with multiple disabilities.

Aim

In this study, it was aimed to test the effectiveness of direct teaching method in teaching puzzle-solving skills to students with multiple disabilities using a tablet computer and to examine the fluency of these skills afterwards. For this purpose, the following questions were addressed:

1. Is direct teaching method effective in teaching puzzle-solving skills to students with multiple disabilities?
2. Do students with multiple disabilities still maintain the skills taught through direct teaching method after 1, 3 and 4 weeks following the completion of instruction?
3. Can students with multiple disabilities generalize these skills taught through direct teaching method to different settings, materials and individuals?
4. Is direct teaching method effective in enabling students with multiple disabilities to reduce the duration for which they solve a puzzle consisting of 12 pieces?
5. Do students with multiple disabilities maintain their pace of solving puzzles after 1, 3, and 4 weeks following the instruction?

Phase 1: Teaching How to Solve a Puzzle through Direct Instruction Method

Method

Participants

The research consisted of one female and two male students, two of whom were in the 9th grade while one was in the 8th grade at a special education vocational school affiliated to the National Education Directorate of Sakarya province. In this article, code names were used instead of the actual names of the participants.

In order to choose participants for the study, the following pre-requisite skills were determined by the researchers: a) having eye-hand coordination, b) following two-action instructions given by the practitioner, c) carrying out verbal instructions, d) directing attention to a given activity, e) staying in place for at least 10 minutes during an activity, f) having been diagnosed with mental disability and additional disability. Off all the students meeting these criteria, three students who volunteered to take part in the study were involved.

Table 1. Demographic Characteristics of the Participants

Participant (Code Name)	Gender	Age	Type of Disability
Kerem	Male	15	Mental disability, cerebral palsy (diplopia), speech disorder
Esra	Female	15	Mental disability, cerebral palsy (diplopia), speech disorder
Mehmet	Male	14	Mental disability, cerebral palsy (hemiplegia), speech disorder

Kerem, one of the participants with intellectual disability in the study, is a student who has been diagnosed with cerebral palsy and has difficulty walking and expressing himself. He is a quiet, responsible student who gets along well with his friends in class. He understands what he reads, but he has a limited capacity to express it. Kerem can use a tablet computer. The participant has no experience with puzzle skills.

Esra suffers from muscle spasm (cerebral palsy) besides intellectual disability, so she has difficulty in walking and speaking. While she has no problem with receptive language skills, she has difficulty in expressive language skills. She understands a text she reads, but fails to explain it adequately. She has difficulty in answering and explaining questions that require the four operations. She feels glad to fulfill her duties and responsibilities. She has good relationships with her friends in the classroom. Esra can use a tablet computer. The participant has no experience with puzzle skills.

Mehmet, who also suffers from intellectual disability, is a student diagnosed with cerebral palsy accompanied with difficulty in walking and speaking. He is at the beginner level in terms of literacy and academic skills and he is unable to answer questions he is asked. He cannot explain an event or phenomenon that he himself experiences or he reads about in a text by setting up a reason-result relationship. He may forget a subject he learns. He feels glad to fulfill his duties and responsibilities. He has no difficulty in comprehending and following instructions he is given. Mehmet can use a tablet computer. The participant has no experience with puzzle skills.

Practitioner

The practitioner holds an M.A. degree in Teaching the Intellectual Disabled, which was awarded by Bolu Abant Izzet Baysal University, Department of Special Education. He continues PhD studies in the same discipline. He also works as a teacher at a special education vocational school in Sakarya province.

Setting and Timing

The baseline, instruction and maintenance sessions were all carried out in the classrooms where the participants were educated. There were four desks, one teacher's desk, one classroom cabinet, one whiteboard and two chairs for teachers in these classrooms. All sessions were held after lunch breaks.

Equipment

For teaching, an Asus tablet computer, 15x15 cm puzzle pictures and 7-piece color puzzles were used. The puzzles used in the baseline of the research, acquisition, permanence and generalization sessions consist of seven pieces of color-pictorial and a composition with a similar level of difficulty. In order to be similar for the difficulty levels of the puzzles to be used in the research, the number of pieces was kept constant. By taking the opinions of two experts working in the field of special education, the puzzles to be used in the research were decided. Among these puzzles that puzzles with colorful pictures that students liked were used in the research. Cardboard puzzles were used. that consisting of 12 pieces of 15x15 cm size in the generalization sessions of the research Furthermore, video recording

was made with a smart phone. To record data, the baseline, instruction, generalization and maintenance form including analysis of the puzzle-solving skills and a data record column prepared by the researchers was used. In addition, the ability to make jigsaw puzzles on the tablet computer is ready for the student cannot see.

Research Model

In this study, which aimed at evaluating the effectiveness of direct teaching method in teaching puzzle-solving skills to students with multiple disabilities, the multiple probe design with probe trials across subjects, one of the single subject methods, was adopted. Initially, baseline data is collected for all three subjects in this model. Upon achieving baseline data stability for the first subject, instruction sessions commence. In the meantime, trial sessions are held with the other two subjects. Once the criteria are met in an instruction session held with the first subject, baseline data collection for the second subject starts until stable data is obtained. After gathering stable data from the second subject, instruction sessions are initiated with him/her, too. Until the second subject meets the first criterion, trial sessions are held with the third subject at intervals to collect data. When baseline data stability is achieved for the third subject, instruction sessions start. Instruction sessions continue until stable data is obtained from this subject, too (Tekin-İftar, 2012). Experimental control of this study was established by observing an increase in the number of correct responses by the participant under instruction, observing no significant change in the responses of the other two participants to whom the skill was not being taught, and producing a positive effect on them in that aspect after instruction sessions started (Tekin-İftar, 2012).

Dependent and Independent Variables

The dependent variable of this research was the participants' level of learning the skills necessary to solve a puzzle. When identifying this skill, their interests and wishes were taken into consideration. It was thought that they would be able to spend their leisure time in a more efficient and high-quality way after acquiring these skills. Before initiating the research, puzzle-solving skills were analyzed as looking at the completed image of a puzzle in the application on the tablet computer (1), looking at its pieces in the application on the tablet computer (2), placing a piece with two straight edges in the appropriate corner of the puzzle (3), finding a piece that fits in terms of color and shape, and putting it in the appropriate place (4), continuing until all pieces are placed (5). The independent variable of this research was direct teaching method which was used to teach puzzle-solving skills.

Implementation Stage

In the first phase of the research, the effectiveness of direct teaching method in teaching puzzle-solving skills to students with multiple disabilities was evaluated; all sessions were arranged as one-to-one instruction and single opportunity method was adopted for evaluation. One session was planned for each weekday. In this process, baseline, instruction, generalization and maintenance sessions were held. After collecting baseline data from all participants, three sessions were held with the first participant to collect baseline data until data stability was achieved. When the criteria were met and stable data was obtained, instruction sessions were initiated. In the meantime, one probe session was held with the other participants after each three sessions. The evaluation data of the research was collected at the end instruction sessions on a daily basis. When the first participant met the first criterion, the baseline sessions were initiated with the second participant. Meanwhile, probe sessions continued with the third participant at intervals (after each three sessions). Upon collecting stable baseline data from the second participant, instruction sessions were initiated, and when the first criterion was met by him/her, the baseline sessions started with the third participant. When baseline data stability was achieved for the third participant, instruction sessions started. 1, 3 and 4 weeks after the completion of the instruction sessions, generalization and maintenance sessions were held.

Baseline Sessions

Prior to baseline sessions, evaluation setting was arranged and prepared. After participants were given the instruction 'to solve a puzzle' as a target stimulant, they were expected to respond within five seconds. Correct response within the allocated time by the participants was marked as (+), whereas incorrect response (putting puzzle pieces into wrong places) and lack of response were marked as (-) on the data collection form. The practitioner did not make any reinforcement against the student's right and wrong responses. While three consecutive baseline data collection sessions were held with the first participant, only one baseline session was held with each of the other two participants to collect data.

Instruction Sessions

Following the completion of necessary classroom arrangement and procurement of essential puzzle-solving tools, the probe "Now, you are going to learn how to solve a puzzle, are you ready?" was given to the participants in order to draw their attention to the task and create necessity awareness. When they said they were ready or gave any indication of being ready, they were reinforced by saying "Great! Now that you are ready, we can start". After presenting the skill instruction, the participants were provided with modelling and verbal clue by uttering the sentence "Now, watch me carefully as I am putting the tablet computer on the table and solving a puzzle". A 15X15cm color photo which showed the completed version of the puzzle was left in front of the participants. At the modeling stage, the practitioner completed the whole puzzle by modelling out loud (“Now, I'm looking at the color of the piece I have just placed. Which piece fits it? This part of it is green. Look! That one has green in it, too. That is the one including the rest of the leaves of the tree.) in accordance with the steps of skills analysis. The modeling phase was repeated once. Then, guided practices was started that the next stage of the direct teaching method. At this stage, what were you supposed to do first after the "do the puzzle" skill instruction? Do you remember? Reminder is presented for the first step. If the student gives the correct answer, s/he is verbally reinforced by saying well done. If the student does not give the correct answer or remains unanswered, the step that should be done verbally is expressed. If the student places the correct piece after verbal clue is given, it is verbally reinforced by saying well done. If it cannot find the right part or remains unresponsive, the cue is given and the appropriate part is marked. Tips as much as the student's needs are provided in the guided applications phase. The guided practice phase for all steps in puzzle making skill analysis was similarly implemented. At this stage, the correct responses of the participants was reinforced while incorrect ones were ignored and the correct behaviors were modelled, instead During the independent practice stage, the participants were asked to solve the puzzle without any help. At the end of the study, each participant was thanked for taking part in this study. Following the independent practices stage, daily evaluations were held. Data on daily evaluations of the target skills was obtained at this stage and shown on a graph.

Maintenance and Generalization Sessions

After the first stage of the study, the acquisition stage, maintenance sessions were arranged after 1, 3 and 4 weeks in order to see how much of the acquired skills was maintained by the participants. Permanence sessions were held with a tablet computer whether the participants retained their ability to make puzzles. In addition, generalization sessions were conducted using different tools, settings and people. In the acquisition stage, students with multiple disabilities were taught the puzzle-solving skill with a tablet computer. However, the generalization sessions were conducted with a puzzle image printed on a cardboard. Also, these sessions were held in another classroom other than the one where the students were educated by a different person (another teacher other than the practitioner).

Reliability and Validity

In the research, two types of data, inter-rater reliability and implementation validity, were collected. The inter-rater reliability of the study was calculated using the formula "agreement/[agreement + disagreement] X 100" (Alberto & Troutman, 2009; Tekin-İftar, 2012). (Reviewer C, it was revised) During at least %30 of the baseline, instruction, maintenance and generalization sessions, reliability data was collected. (Reviewer C, reliability data was collected by watching %30 of the session videos) The inter-rater reliability score was found out to be %98 for the baseline sessions, %96 for the daily evaluation sessions, %100 for the maintenance sessions and %94 for the generalization sessions.

Data on validity of the study was calculated using the formula "observed behavior/target behavior x 100" (Alberto & Troutman, 2009; Tekin-İftar, 2012). Validity data was collected in 30% of the sessions. This data was obtained by a teacher with approximately ten-year of teaching experience in special education. The validity score was measured as 100% for all participants.

Data Analysis

The data was analyzed through graphical analysis in this study. The x axes of the graphs prepared based on the obtained data represent the baseline, generalization, instruction and follow-up sessions while the y axes represent the percentages of the correct responses by the participants in puzzle-solving, which is the dependent variable of the study. Experimental control of the study was determined by examining whether any diachronic change in the dependent variable was observed when the independent variable was applied.

Results

In this section of the paper, findings on the effectiveness of direct teaching method in the acquisition, maintenance and generalization of the puzzle-solving skills by students with multiple disabilities are given.

Findings on the Effectiveness of Direct Teaching Method in Teaching Puzzle-Solving Skills

All related data has been demonstrated on a graph for all participants. The x axis of the graph represents the number of sessions while y axis represents the percentages of correct responses obtained during generalization, instruction and maintenance sessions.

Probe data was evaluated considering the baseline sessions, daily probes in instruction sessions, trial sessions held after each three instruction sessions, and maintenance and generalization sessions. As for the maintenance sessions, participants' reactions during the sessions held 1, 3, and 4 weeks after the completion of the instruction sessions were taken into consideration. Figure 1 represents the graph on puzzle-solving skills below.

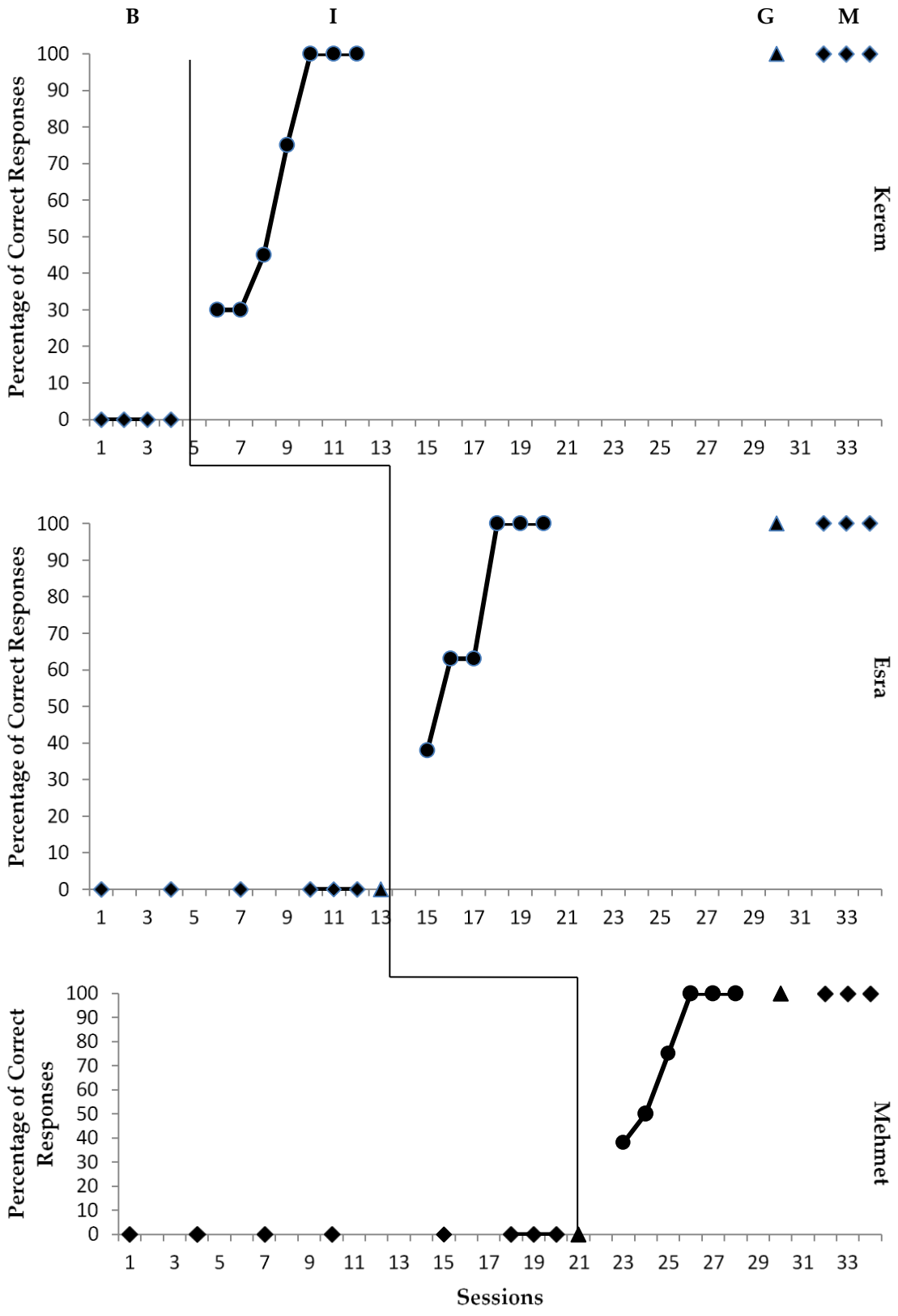

Figure 1. The participants' correct response percentages during the baseline (B), implementation (I), generalization (G) and maintenance (M) sessions.

Findings on the Effectiveness of Direct Teaching Method in Teaching Puzzle-Solving Skills to Kerem

The percentages of Kerem's responses during baseline, instruction, generalization and maintenance sessions are shown in Figure 1. His performance in solving a puzzle was calculated as 0% during the baseline sessions. After obtaining stable data in the baseline sessions, the instruction sessions were initiated with him.

Seven instruction sessions were held to teach him the target skills using the direct teaching method. Probe sessions were held during the independent practices stage of the teaching. The percentage of his correct responses was 30% in the first and second sessions, 45% in the third session, 75% in the fourth session, and 100% in the last three sessions. Since the participant's performance was over %80 after seven instruction sessions, he met the criteria. The instruction sessions lasted for 16 minutes and 57 seconds.

Findings on the Effectiveness of Direct Teaching Method in Teaching Puzzle-Solving Skills to Esra

Esra did not respond correctly in any of the baseline sessions or probe sessions. Six instruction sessions were held to teach her the skill using the direct teaching method. Probe sessions were held during the independent practices stage of the teaching. Her performance was 38% in the first session, 63% in the second and third sessions, and 100% in the fourth, fifth and sixth sessions. Since the participant's performance was over %80 after six instruction sessions, she met the criteria. The instruction sessions lasted for 14 minutes and 52 seconds.

Findings on the Effectiveness of Direct Teaching Method in Teaching Puzzle-Solving Skills to Mehmet

Mehmet did not give any correct response in any of the baseline sessions or probe sessions. Six instruction sessions were held to teach him the skill using the direct teaching method. Probe sessions were held during the independent practices stage of the teaching. His performance was 38% in the first session, 50% in the second session, %75 in the third session, and 100% in the fourth, fifth and sixth sessions. Since the participant's performance was over %80 after six instruction sessions, he met the criteria. The instruction sessions lasted for 18 minutes and 42 seconds.

Findings on Maintenance

The maintenance sessions were held at the end of the first, third and fourth weeks after the completion of the instruction and generalization sessions in order to determine how much of the puzzle-solving skills was still maintained. It was found out that the maintenance level of all participants was at 100%.

Findings on Generalization

In this study, generalization sessions aiming at determining the participants' generalization ability of the puzzle-solving skills were conducted by using different settings, materials and people. Related data was collected both prior to and following the instruction sessions, using the pretest-posttest design. The data is shown in Figure 2.

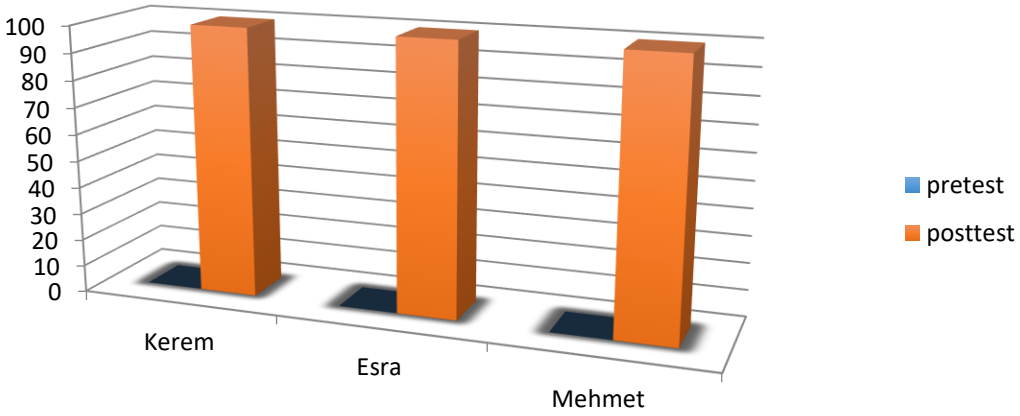

Figure 2. The percentages of The Participants' Ability to Generalize The Puzzle-Solving Skills

As shown in Figure 2, the success level in the pretest was 0% for all participants, while it increased significantly to 100% in the posttest.

Phase 2: Increasing the Fluency of Students with Multiple Disabilities in Puzzle-Solving Skills with a Tablet Computer

Participants and Practitioner

This phase of the study was performed with the same participants who had taken part in the first phase. Similarly, the same practitioner, who had conducted the first phase, carried out the second phase of the research.

Setting, Duration and Equipment

The second phase of the study was carried out in the participants' own classroom. The practitioner, one participant and another student who wasn't a part of the study but responsible only for data-recording were present in each session.

In the second phase, an Asus brand tablet computer, 12-piece puzzles and 15x15 cm color pictures of the puzzles were used. Also, a smart phone was used for video recording. A daily evaluation and maintenance form was used to record the data. This form included puzzle-making skills' analysis and a data record column.

Research Model

In the second phase of the study, the changing criterion design, one of the single-subject research designs, was used. In this model, it is expected to observe the effects of a series of interventions on a particular behavior gradually. Two fundamental phases of this model are the baseline phase and implementation phase. The dependent variable is constantly observed and measured during the baseline phase, and participants' performance related to the dependent variable is evaluated. Once stable data is obtained, implementation phase starts. The implementation phase consists of some sub-phases. A criterion for target behavior is determined by considering the performance observed during the baseline phase. In addition, sub-criteria are determined to achieve this criterion. In the first sub-phase, teaching starts and it continues until the determined criterion is met and stable data is obtained. Then, intervention aiming at another criterion is initiated and continued until that criterion is also met, which constitutes the second sub-phase of the implementation. In the third sub-phase, a new criterion is determined. The implementation is continued until that criterion is achieved, as well (Tekin-İftar, 2012).

Dependent and Independent Variables

The dependent variable of this phase is the duration for which the participants complete a puzzle.

The independent variable, on the other hand, is the direct instruction method. The method was applied to three different students and each student was studied one-to-one.

Baseline Sessions

According to the research model used in the second phase of the study, baseline sessions are suggested in order to maintain experimental control, although it is not a necessity (Tekin-İftar, 2012). For this same reason, baseline sessions were held in this study before implementation sessions took place. Before starting the baseline sessions, the evaluation setting was arranged and prepared. In these sessions, durations for which the participants completed puzzles were observed by timing. These durations starting as of the instruction to solve the puzzles were recorded on the data record form. Three baseline sessions were held with each participant to collect relevant data.

Instruction Sessions

The instruction sessions were held using the changing criterion design, one of the single-subject designs, in this phase of the study. A criterion for target behavior was determined by considering the performance observed during the baseline sessions. In accordance with the design, which recommends arranging at least three sub-phases (Tekin-İftar, 2012), implementation sessions were held under four sub-phases in order to increase the participants' fluency in the acquired skills.

According to the changing criterion model, this criterion should be %10-%15 lower than average occurrence of a target behavior if the aim is to reduce it, while it should be %10-%15 higher if the aim is to increase the occurrence of the target behavior (Tekin-İftar, 2012). Since each sub-phase served as the baseline for the next one, the criterion for the next sub-phase was set by calculating 10% of the data obtained during a sub-phase (Tekin-İftar, 2012). Therefore, in this study, which aimed at reducing the duration for which the participants completed puzzles, a criterion that was %10 lower than the preceding session was set for each sub-phase. Following the completion of necessary classroom arrangement and procurement of essential puzzle-solving tools, the probe "Now we are going to try to do the puzzle making skills that we learned by looking at the stopwatch of the phone with you in a short time, are you ready?" was given to the participants in order to draw their attention to the task and create necessity awareness. When they said they were ready or gave any indication of being ready, they were reinforced by saying "Great! Now that you are ready, we can start". For the first sub-phase, a low criterion of 10% of the performance was determined that the subject exhibited in the last session of the baseline level Later, after presenting the " make puzzle " skill instruction, the stopwatch of the smartphone was operated. The stages of direct instruction method (need creation, modeling, guided practices, independent practices) were applied for each sub-phase as stated in the teaching sessions of the first part of the research. At the end of the study, each participant was thanked for taking part in this study. Following the independent practices stage, daily evaluations were held. Data on daily evaluations of the target skills was obtained at this stage and shown on a graph.

Maintenance Sessions

In this phase of the study, maintenance sessions were conducted in order to determine the extent to which the participants maintained their pace of solving puzzles.

Reliability and Validity

In this phase of the study, data on the inter-rater reliability and validity was collected during 30% of the sessions, too. The data was collected by a special education teacher experienced in direct teaching method doing a PhD in the field of special education. The inter-rater reliability of the study was calculated using the formula "agreement/[agreement + disagreement] X 100"(Tekin-İftar, 2012). The average inter-rater reliability of the baseline, instruction and maintenance sessions was calculated as 96%, while this figure was %98 for the instruction sessions and %100 for the maintenance sessions.

Data on validity of the study was calculated using the formula "observed behavior/target behavior x 100" (Tekin-İftar, 2012). Validity data was collected considering the following: a) equipment control, b) an attention-grabbing probe, c) modeling, d) giving enough clues to students, e) providing students with the opportunity of practicing independently, f) giving appropriate reactions to students after practice, g) keeping a color visual clue during teaching. The validity average related to all responses and participants was calculated as %100 in the study.

Data Analysis

In this study, the data obtained from the baseline, implementation and follow-up sessions held in order to evaluate the maintenance of fluency in the acquired skills was analyzed by graphical analysis method. The x axis of the graph represents the baseline, implementation and follow-up sessions, while the y axis shows the duration of correct responses by the participants.

Results

In this part of the paper, the findings on the efficiency of using direct teaching method to increase the fluency of students with multiple disabilities in puzzle-solving are given.

Findings on the Fluency of the Participants in Solving Puzzles

All data on the students' fluency in solving puzzles has been shown on a graph. The x axis of the graph shows the number of sessions, while the y axis shows the duration of the completion of a puzzle by a participant during fluency sessions. In order to help the participants improve fluency in puzzle-solving, baseline sessions, implementation sessions (each of which consisted of four sub-phases), and follow-up sessions (following the implementation sessions) were held. The probe data was obtained during the baseline and instruction sessions. The related graph is shown in Figure 3.

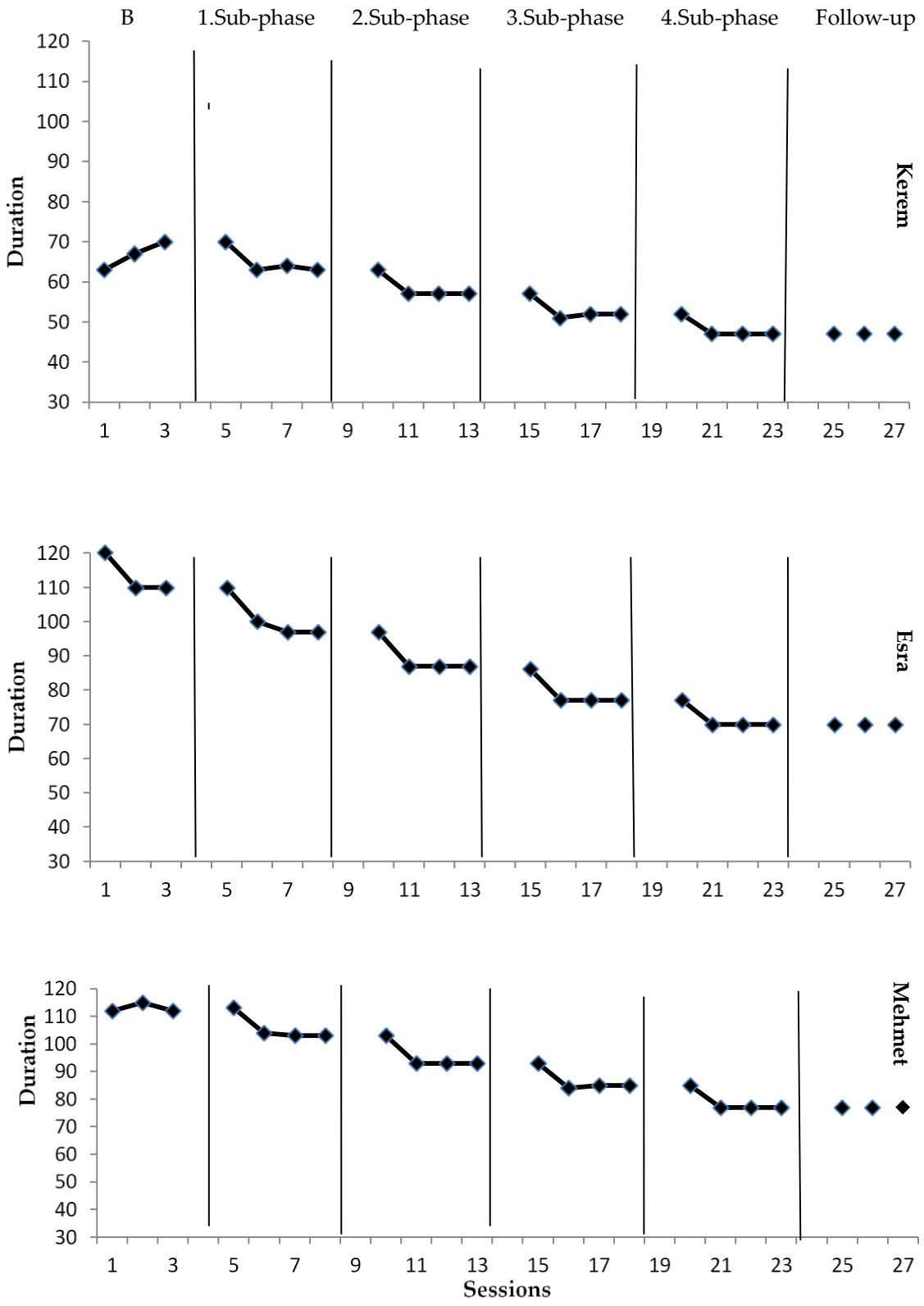

Figure 3. The duration of correct responses by the participants in fluency sessions (in seconds)

While attempting to improve the participants' fluency in solving puzzles on a tablet computer, it was aimed to reduce the duration by %10 in each sub-phase compared to the preceding sub-phase. The findings related to this objective are given in the next part.

Findings on Kerem's Fluency in Puzzle-Solving Skills

Table 2. Phase Averages Related to Fluency in Puzzle-Solving, Criteria Ranges and Data Percentages Verifying the Criteria Range for Kerem

Phases	Phase Averages	Criteria Ranges	Data Percentages Verifying Criteria Range
Baseline Level	66.6	73,2-60	%100
1. Sub-Phase	65	71,5-58,5	%100
2. Sub-Phase	58.5	64,3-52,7	%100
3. Sub-Phase	53	58,3-47,7	%100
4. Sub-Phase	48.2	53-43,4	%100
Maintenance	47	51,7-42,3	%100

During the baseline sessions which were held to improve fluency in the acquired skill, Kerem demonstrated the skill in 63 seconds in the first session, in 67 seconds in the second session and in 70 seconds in the third session. As for the implementation stage, during the first sub-phase, he fulfilled the task in 70 seconds in the first session, in 63 seconds in the second session, in 64 seconds in the third session and in 63 seconds in the fourth session; during the second sub-phase of this stage, however, he demonstrated the skill in 63 seconds in the first session, while he fulfilled the task in 57 seconds in the second, third and fourth sessions. In the third sub-phase, it took him 57 seconds in the first session, 51 seconds in the second session and 52 seconds in the third and fourth sessions to complete a puzzle. During the fourth sub-phase, he demonstrated the skill in 52 seconds in the first session, whereas he spent only 47 seconds in the second, third and fourth sessions to do so. A total of 16 practice sessions were held with Kerem in order to enable him to gain fluency in the acquired skills.

Findings on Esra's Fluency in Puzzle-Solving Skills

Table 3. Phase Averages Related to Fluency in Puzzle-Solving, Criteria Ranges and Data Percentages Verifying the Criteria Range for Esra

Phases	Phase Averages	Criteria Ranges	Data Percentages Verifying Criteria Range
Baseline Level	113,3	124,6-102	%100
1. Sub-Phase	101	111,1-90,9	%100
2. Sub-Phase	89.5	98,4-80,6	%100
3. Sub-Phase	79,2	87,1-71,3	%100
4. Sub-Phase	71,7	78,8-64,6	%100
Maintenance	70	77-63	%100

During the baseline sessions which were held to improve fluency in the acquired skill, Esra demonstrated the skill in 120 seconds in the first session, while she did that in 110 seconds in the second and third sessions. During the first sub-phase of the implementation, she completed the task in 110 seconds in the first session; but she did that in 100 seconds in the second session and in 97 seconds in the third and fourth sessions. In the second sub-phase, she fulfilled the task in 97 seconds, yet, this figure dropped to 87 in the second, third and fourth sessions. In the third sub-phase, she needed 86 seconds for that in the first session, whereas she spent 77 seconds solving a puzzle in the second, third and fourth sessions. During the fourth sub-phase, she demonstrated the skill in 77 seconds in the first session, and this figure decreased to 70 in the second, third and fourth sessions. A total of 16 practice sessions were held with Esra in order to help her achieve fluency in the acquired skills.

Findings on Mehmet's Fluency in Puzzle-Solving Skills

Table 4. Phase Averages Related to Fluency in Puzzle-Solving, Criteria Ranges and Data Percentages Verifying the Criteria Range for Mehmet

Phases	Phase Averages	Criteria Ranges	Data Percentages Verifying Criteria Range
Baseline Level	113	124,3-101,7	%100
1. Sub-Phase	105,7	116,2-95,2	%100
2. Sub-Phase	95,5	105-86	%100
3. Sub-Phase	86,7	95,3-78,1	%100
4. Sub-Phase	79	86,9-70,4	%100
Maintenance	77	84,7-69,3	%100

During the baseline sessions, Mehmet demonstrated the target skills in 112 seconds in the first session, in 115 seconds in the second session and in 112 seconds in the third sessions. During the first sub-phase of the implementation, he fulfilled the task in 113 seconds in the first session and in 104 seconds in the second session; yet, he spent 103 seconds in the third and fourth sessions to do that. In the second sub-phase, he demonstrated the skill in 103 seconds in the first session, while this number dropped to 93 in the second, third and fourth sessions. In the first session of the third sub-phase, he spent 93 seconds to complete a puzzle, but it took him 84 and 83 seconds in the second and third sessions to demonstrate the skill, respectively. During the fourth sub-phase, he solved a puzzle in 85 seconds in the first session; nevertheless he did that in only 77 seconds in the second, third and fourth sessions. 16 practice sessions were held with Mehmet in total in order to help him get fluent in the acquired skills.

Findings on Maintenance

In this study, follow-up data was collected to determine the extent to which the participants maintained their puzzle-solving durations at the end of weeks one, three, and four after the implementation sessions, each of which consisted of four sub-phases, were over.

The follow-up sessions revealed that all participants, Kerem, Esra and Mehmet, maintained their durations.

Discussion

In this study, the effectiveness of direct teaching method in teaching the puzzle-solving skills to students with multiple disabilities with a tablet computer and improving their fluency in these skills were investigated. Research findings showed that this method was effective in teaching puzzle-solving skills to those individuals, the participants could generalize the acquired skills to different settings, people and materials, the skills were still maintained at the end of weeks one, three and four, and the target skills were demonstrated in a shorter period of time compared to the applied criteria. In addition, while the subjects could not demonstrate these skills in the generalization sessions held before the instruction sessions, they were 100% successful in solving puzzles during the generalization sessions conducted at the end of the instruction sessions.

There is no research on the use of assistive technology in teaching leisure time skills to individuals with multiple disabilities in the field of special education. However, in one study, the effects of the fragmented puzzle game played on a tablet computer on children with autism spectrum disorder were examined. Chan (2013) taught puzzles to children with autism spectrum disorders via a tablet computer. At the end of the research, the subjects gained the target skill via a tablet computer. In the research conducted, subjects with multiple deficiencies gained the ability to make puzzles via a tablet computer. When examined from this point of view, the findings of both studies are parallel. These findings are important in terms of showing the effect of using tablet computers in teaching leisure time activities to different disability groups. However, it should be noted that more studies are needed on the subject.

Considering the research method, the direct teaching method allowed the participants to practice the puzzle-solving skills under teacher guidance. Also, it gave them the opportunity of being observed by someone else just as they were displaying the skills and having practice on their own. Also, the participants made fewer mistakes when applying them and had instant feedback. Based on this, it can be said that the participants could recall what they had learned better and they could acquire the target skills sooner.

A number of studies on teaching leisure-time skills to individuals with multiple disabilities are available in the literature. Dutt (2010) studied teaching toy selection skills to individuals with severe and multiple disabilities; Holburn et al. (2004) studied the use of a micro-switch to change photographs in a PowerPoint presentation with five adults with severe physical and mental disabilities; Lancioni et al. (2010) did research on teaching the skill of using a television to an adult with multiple disabilities. The use of technology for teaching leisure time skills was taught to individuals with multiple disabilities in the researches. Therefore, although there are studies on teaching leisure time skills to individuals with multiple disabilities, there is no research on teaching the skill of puzzle by using direct teaching method and ensuring the fluency of the taught skill. Tablets were used in the study and the fluency of the taught skill was achieved. This makes the research different from other studies.

In the research, it is aimed to gain the students with multiple disabilities the ability to make puzzles via a tablet computer. At the end of the research, the subjects realized the skill desired to be acquired via a tablet computer. It is possible to come across research that uses a tablet computer to gain skills for individuals with disabilities in the literature. Acungil (2014) examined the effectiveness of the tablet computer curriculum in teaching the ability to use tablets to individuals with mild to moderate intellectual disabilities. At the end of the research, the subjects achieved the target skill using a tablet computer. The findings of the study carried out by Acungil (2014) support the findings of the research. Bahçalı (2016) examined the effectiveness of teaching the ability to conduct job interviews with the video model presented with a tablet computer to individuals with developmental disabilities. At the end of the research, subjects demonstrated the target skill. In the research, the subjects realized their puzzle skills via a tablet computer. When examined from this point of view, the findings of the study of Bahçalı (2016) are in line with the findings of this study. Eliçin (2015) examined the effectiveness of the program offered via a tablet computer in providing functional reading skills to children with autism spectrum disorders. At the end of the research, children with autism spectrum disorders achieved the target skill. When examined from this point of view, the research findings of Eliçin (2015) support the findings of the research.

Another finding of the study was that the participants were able to solve puzzles in less time than the determined criteria. When the literature is reviewed, similar studies aiming at improving fluency in target skills can be encountered (Küçüközyiğit & Özdemir, 2016; Saygılı & Ergen, 2016), with the findings of which this study is consistent. Küçüközyiğit and Özdemir (2016) and Saygılı and Ergen (2016) conducted studies to provide fluency of academic skills to individuals with disabilities. In this study, the fluency of the taught skill was provided after teaching leisure time skills to individuals with multiple disabilities. This reveals the difference of this research from other studies.

One of the issues of the research that should be discussed is its limitation. The research is limited to the participants who participating in the research, the method used to teach the skill to be acquired, the research model and the dependent variable. On the other hand, in this study, the subjects with multiple disabilities were studied; following the instruction session during which the participants were taught the puzzle-solving skills, then more sessions were held to evaluate their fluency in the target skills. In this respect, it exhibits an original aspect among all the studies on fluency available in the literature.

Conclusion and Recommendations

The study revealed that all of the participants exhibited the puzzle-making skills by achieving the %100 criterion and they were able to generalize the skills to different people, materials and settings. Furthermore, it was seen that they still maintained their ability 1, 3 and 4 weeks later. Moreover, during the fluency sessions held after the acquisition sessions, it was observed that the participants could complete a puzzle in a shorter time period in accordance with the set criteria.

In the light of these findings, the following recommendations can be offered:

1. Students with multiple disabilities can be taught the fluency of the puzzle skill with more pieces.
2. Students with multiple disabilities can be taught different leisure-time skills using the direct teaching method.
3. It is recommended that similar research on teaching leisure-time skills be conducted in other settings and by different practitioners.
4. In this study, only participants with multiple disabilities were included. However, participants with other developmental disabilities can be taught different leisure-time skills.
5. In this study, the students with multiple disabilities were taught how to solve puzzles on a tablet computer. Other leisure-time skills can also be taught with some other tools.

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