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Comparison of the Different Presentations of Concrete-Representational-Abstract (CRA) Sequence to Teach Functional Academic Skills for Students with Developmental Retardation

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Abstract: The research aims to compare the use of 3D materials and video prompting presentations in terms of their effectiveness and efficiency in implementing the CRA teaching strategy. Four students with developmental retardation, aged 8 to 10, participated in the study. The design of the alternating treatment, one of the single-subject research designs, was employed in the research. In addition, in the research, social validity data were collected with the interview form consisting of semi-structured interview questions, and content analysis was performed. The study's dependent variables are the subjects' ability to accurately tell the time and recognize money. There are two independent variables in the study. The first independent variable is the presentation of the CRA teaching strategy with 3D materials, and the second independent variable is the presentation of the CRA teaching strategy with video prompting. Functional academic skills teaching was applied to four selected students alternately using 3D materials and video prompting. A total of 135 sessions took place in the experimental process. As a result of the research, it was found that both presentation styles were effective, but video prompting presentation was more efficient. These results show that the CRA teaching strategy with video prompting can be used to teach functional academic skills to students with developmental retardation. Both teachers and families expressed positive opinions about the skills handled by both methods. The use of video prompting in schools and homes can be beneficial when teaching functional academic skills to individuals with special needs.

Keywords: developmental retardation; CRA; video prompting; learning strategies

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1. Introduction

Individuals with special needs are expected to participate in social life like individuals with normal development, to be able to use what they learned at school effectively, and to establish and maintain meaningful relationships with other individuals in society. Gaining all the skills necessary for individuals with special needs to adapt to social life will enable them to function effectively daily at home, school, work, and in society [1]. Functional academic skills are important skills that these individuals need to acquire to adapt to social life and function independently. Functional academic skills are telling time, calculating, note-taking and reading, writing, and mathematics learning in early childhood and preschool. They can be used throughout life while performing daily activities. Considering today's technologically advanced societies, the need for these skills has increased and is expected to be exhibited at a more advanced level [2].

Basic math skills are important among functional academic skills [3]. Functional academic skills include teaching real-life situations such as telling time, using money, and measuring [4]. Functional academic skills such as using money, making transactions, using a watch, shopping, and counting are functional skills frequently used in daily life [5]. Therefore, it is important to include functional academic skills (such as recognizing money and telling the time) in the education programs for students with developmental retardation. Developmental retardation is a group of conditions due to an impairment in physical, learning, language, or behavior areas. These conditions begin during the developmental period, may impact day-to-day functioning, and usually last throughout a person's lifetime [6].

Individuals with special needs often exhibit deficiencies in recognizing and calculating money [7–10]. For individuals with special needs to be able to make purchases, it is necessary to teach them the ability to use money, one of the functional academic skills. Teaching the concept of money, which facilitates the daily lives of individuals, should follow a certain order in the individual's education. The opportunity to practice and real-life experiences should be provided to the individual to apply the skill of recognizing money, which is taught to enable individuals with special needs to buy the things they need. Instruction should be planned to meet the needs of each individual. The concept of money should be presented simultaneously with the teaching of the concept of numbers. Such a sequence facilitates the application of learned skills. Following the teaching of number and calculation skills, teaching appropriate money skills helps the individual learn step by step. In teaching skills, individuals should be given opportunities and activities to generalize their learned skills using goods, services, entertainment, etc. The opportunity to use money should be offered [11].

Another functional academic skill important in an individual's daily life is the ability to tell the time. Considering that the work will be done within a certain plan in daily life, it will be understood how often the individual will use the skill of telling the time and how important it is. However, the ability to tell the time may not be the same for all individuals [12]. McGuire [13] emphasized that the clock is an abstract concept, so it would be difficult to learn the skill of telling the time. In addition, it is thought that it is because there are too many details that individuals need to pay attention to while reading the watch. In addition to the numerals one to twelve on the clock, there are two long and one short bar pointing to the numerals. For the individual to understand what time it is, they need to know which number these bars show, in which direction the bars rotate, and some similar variables [14]. Therefore, learning the clock requires prerequisite skills [12].

The prerequisite for telling the time is understanding the concept of time as a unit and a sequence of events. Year, calendar, month, week, tomorrow, today, yesterday, and next week are the basic concepts for understanding time. Individuals with developmental retardation have more difficulty reading analog clocks than digital clocks [15]. However, analog wall clocks are widely used in homes and schools. Therefore, teaching students the ability to read analog clocks will be a more functional skill [16]. It has been shown in clinical observations and many studies that individuals with special needs have difficulties in perceiving time and using time-related skills such as clocks in daily life [17,18]. Therefore, the skill of telling the time, which is a part of the difficulties experienced with the concept of time and is an important prerequisite for skills such as daily life planning and time management [19,20], is important for individuals to acquire. In the literature, there are studies on the teaching of telling the time [21–25].

Individuals with developmental retardation need an education that includes functional academic skills. Because of the difficulties experienced in academic duties, inadequacy and negative feelings may begin in addition to school failure in individuals [26]. As in other areas of development, which teaching method will be taken as a basis in teaching academic skills should be decided by taking into account the characteristics of the student, his qualifications, level of development, interests, etc. [27], because, like every individual, individuals with developmental retardation may have different learning processes and methods due to their differences. At this point, teachers play a big role. It is very important to plan the teaching in a way suitable for the student and to choose the appropriate technique, presentation, and method for the skill.

When the literature is examined, strategies that have important effects on teaching mathematics skills to individuals with developmental retardation have been suggested [28]. In research; point identification [29], number lines [30], close, copy, compare (CCC) [31], CRA [32–34], strategies that ignore numbers, strategies that teach the use of item sets, and that teach the use of domain models [35,36] are widely used.

In the literature, the effects of the CRA strategy, one of the strategies used in teaching functional academic skills, and the use of mathematical concepts and skills in the teaching process and productivity [32,37] are investigated. The CRA teaching strategy is a conceptual construct consisting of concrete, progressive constructs that can make a meaningful connection between concrete, representational and abstract levels of a concept or skill. It is a support strategy [33,34]. It is the tangible level of using objects you can touch and move, representational, where lines, shapes, and drawings are used to represent objects, and the abstract level, where only numbers, mathematical symbols, and formulas are used [38,39]. As in Figure 1 this strategy consists of three levels.

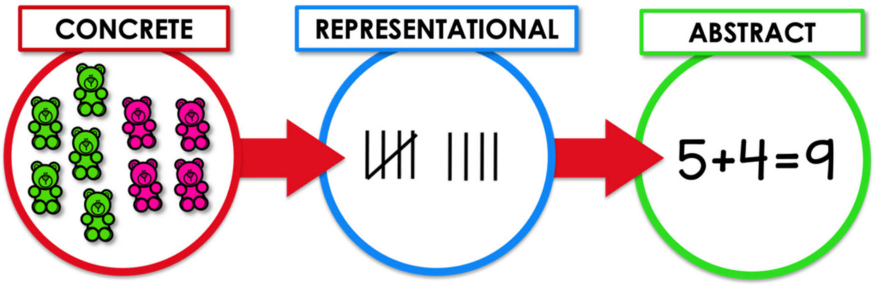

Figure 1. Three stage of CRA.

CRA strategy first creates a degree of mental maturity to establish meaningful relationships between mathematical formulas and concrete objects through experience using object manipulation. It uses symbolic, two-dimensional representations such as straight lines, circles, and points connecting concrete and abstract levels. It shows the animation of moving objects on a tangible level. Finally, gaining sufficient experience at the concrete and representational levels is necessary to progress to the abstract level. Students can express the mathematical formulas they encounter at the abstract level by "imagining" the "made" and "drawn" situations in the previous level, using only the numbers and symbols written on the paper [28].

While providing functional academic skills to students with developmental retardation, the presentation of these methods and strategies is also very important apart from the method and strategy. For example, the materials used in teaching should be chosen from real objects used at home. This makes it easier for children to generalize what they have learned at home using familiar things in their real life. It is important to pay attention to this when applying the CRA teaching strategy. Models, drawings, or pictures of 3D objects can be used and 3D objects to help students generalize what they have learned [40]. It may be useful to use a 3D concrete object for the concrete stage, a 3D painting for the representational stage, or a 3D drawing for the abstract stage as material. What is desired to be emphasized with functionality is that the knowledge and skills to be taught are useful and useful in daily life, at home, and in the community.

In recent decades, technology, specifically video-based interventions, has been introduced in schools and has become a commonly used practice in education, providing numerous benefits for teachers and students [41]. Education with video modeling uses evidence-based applications that demonstrate and teach the concepts or skills [42]. Video modeling instruction combines the principles of procedural technology. It has all the advantages of video model instruction, such as combining evidence and research-based teaching practices to achieve an independent response, personalization, and motivation [43,44]. Many researchers argue that video modeling methods are effective because they combine new skills or behaviors with very popular video-watching activities [45]. Students with developmental retardation can benefit from using computer-based video technologies as they can increase their visual intensity. Various strategies are beneficial in teaching functional academic skills. These include virtual manipulatives [46], video prompting, and technology-assisted video modeling. It has been revealed that implementing these strategies effectively improves the students' learning speed and the individual learning process [47].

The reason for the difficulties experienced by students with developmental retardation in learning functional academic skills and concepts is that appropriate teaching content is not prepared or presented in the literature. Therefore, preparing and presenting appropriate teaching content is based on selecting effective methods and techniques. In the literature, many techniques and methods are used to teach functional academic skills and concepts to students with developmental retardation. One of these effective methods and techniques is the CRA teaching strategy. Although many studies [16,28,33,38,48] appear in the literature on the acquisition of functional academic skills by the CRA teaching strategy, no research has been found on how this strategy will be more effective and productive. In addition to the fact that one teaching method is more efficient than the other teaching method, the result of the teaching is more effective; it can be characterized as the necessity of completing it earlier, resulting in less effort and enabling children to acquire skills by making fewer mistakes [49]. For these reasons, whether the method differs in terms of the effectiveness required for acquiring the skill, less effort, making fewer mistakes in less time, and maintaining and generalizing the skills is extremely important. Therefore, there is a need to plan research to determine effective and efficient teaching methods for helping students with developmental retardation gain functional academic skills. This research was designed to meet this requirement.

This research aims to compare two different presentations of the CRA strategy (video prompting and 3D materials) in terms of effectiveness and efficiency in gaining functional academic skills for students with developmental retardation; this study aims to determine the views of the parents and teachers of the students participating in the research on two different presentations of the CRA strategy. For this purpose, answers to the following questions were sought:

1. Is there any difference in effectiveness in the acquisition, monitoring, and generalization stages between teaching practices made with two different presentations of a concrete–representational–abstract teaching strategy (video prompting and 3D materials treatment) in gaining functional academic skills for students with developmental retardation?
2. In the teaching of functional academic skills to students with developmental retardation, between two different presentations of the CRA strategy (video prompting and 3D materials treatment) until the criterion is met; is there a difference in terms of (a) a number of sessions, (b) a number of attempts, (c) number of incorrect responses, (d) total teaching time?
3. What are the views of the parents and teachers of the students participating in the study on the targeted functional academic skills (the ability to reading the time and recognize money), the methods applied, and the findings obtained?

2. Materials and Methods

This section provides detailed information on the participants of the research, the environment and details on the time of the conducted research, the tools and materials used, the dependent and independent variables of this research, the research model, possible student reactions, the experiment process, and the general process are included.

2.1. Research Design

In this study, a single-subject research method was used to determine the efficiency and effectiveness of teaching with the two different presentations of the CRA to children with developmental retardation as video prompting and 3D presentation. The adaptive alternating treatment model was chosen among the single-subject research methods. The adaptive alternating treatment model is a model in which the effects of two or more independent variables on two or more irreversible dependent variables are compared [50]. In the study, there are two dependent and two independent variables. In the adaptive alternating treatment model, there are dependent variables with equal difficulty levels for each independent variable but which are functionally independent of each other [51]. For this reason, the adaptive alternating treatment model was the most suitable model for comparing effectiveness.

In the adaptive alternating treatment model, the change in the level and trends of the data collected during the comparison phase was controlled, and there was an attempt to determine whether or not experimental control was established. Each independent variable was studied in the research; by choosing the functionally independent skills whose difficulty levels should be at the same level, the possibility of each variable affecting each other in the teaching processes has been minimized as far as possible. The following points were taken into consideration in the treatment of the adaptive alternating treatment model: (a) a dependent variable is defined for each independent variable, and (b) care was taken to ensure that the dependent variables were of equal difficulty level and functionally independent from each other, (c) two instruction sets were created for each dependent variable, (d) in the treatment of the two models, rapid transformations of the independent variables are ensured (within the same day), and (e) the order of application of the independent variables is given in a mixed manner.

More than one point was considered when choosing the adaptive transformative applications model. These are that the research can provide benefits in line with its purpose, be easy to plan and implement, allow two target behaviors to be practiced with only one participant, allow easy control of the factors affecting internal validity, enable comparison analysis, component, and parameter analysis, and do not need to withdraw an effective application. It was preferred because it is a model that does not cause many ethical problems. Using the adaptive alternating treatment model for this study provides the opportunity to determine the similarities or differences in effectiveness and efficiency when the proficiency levels of the same participants are taught with two different presentations, with similar difficulties, by two different presentations. The major advantage of the alternating treatment design is that it does not require a withdrawal of treatment. A second advantage is that the individual phases can be very short in duration, and the comparison can be made quicker than with traditional AB designs. A third advantage is that there is no requirement for the baseline phase [52].

2.2. Dependent and Independent Variables

The independent variables of this research are the two different presentations of the two topics or dependent variables. The independent variables are the two presentations about the concrete–representational–abstract teaching strategy using video prompting and the presentation of the CRA teaching strategy using 3D materials.

The dependent variables of the research, which are shaped by the independent variables mentioned above, are the students' abilities to tell the time and recognize money. The first dependent variable is the ability to tell the time and read the full hours of the day by looking at the digital clock. The second dependent variable of the research includes the ability to recognize money and the ability to read daily currencies such as paper banknotes with values of TRY 5, 10, 20, 50 and 100. Within the scope of the research, the criterion for teaching skills was determined as 100%.

The video recording method recorded all application data in the research process. Independent observers conducted an inter-observer reliability analysis on at least 20% of these records. The measurement factor was prevented from threatening the internal validity of the research.

2.3. Selection and Characteristics of Participating Students

Four male students aged between 8 and 10, who had the same levels of performance with similar characteristics, participated in the study. They all have been diagnosed with developmental retardation and had the same level of proficiency (0%) in telling the time and recognizing money. All participant students have slow processing and slow motor skills. There are serious limitations and slow learning problems, especially in functional academic skills. There are no sensory or physical limitations in the participating students. For the pilot application, Çınar (8), for the experimental process Salih (10), Muhammed (8), and Ege (9) are the code names that will be used during the research. The participant with the code name Çınar was diagnosed with developmental retardation and had since received regular training at a special education center for three years. The participant code-named Salih was diagnosed with developmental retardation four years ago and has received regular training at a special education center for three years. The participant code-named Muhammed was diagnosed with developmental retardation 2.5 years ago and had been training regularly at a special education center for 2.5 years. The participant, code-named Ege was diagnosed with developmental retardation five years ago and received regular training at a special education center for four years. Before starting the research, the performances of all participants were taken to determine their levels of reading the time and recognizing money. It was determined that the participants' proficiency and readiness levels in the skills aimed to be taught were similar.

2.4. Environment and Tools

The baseline, treatment, follow-up, and generalization sessions of the research were carried out in the individual education room of the special education and rehabilitation center in the 2021–2022 fall semester where the students were attending. Considering the school's course hours, the students were taught between 09:00–11:00–14:00–16:30 on Monday, Tuesday, and Thursday, and each session duration was 40 min. In the scope of the research, different teaching sets were used for each stage suitable for teaching the concrete–representational–abstract teaching strategy. In the teaching set, there is an analog clock model for the ability to read the clock in the concrete stage, picture cards representing the analog clocks in the representational stage, and digital clock images in the abstract stage (Figure 2).

Figure 2. Sample of materials.

In contrast, the real TRY 5 paper banknotes, TRY 10 paper banknotes, TRY 20 paper banknotes, TRY 50 paper banknotes, and TRY 100 paper banknotes in the concrete stage are used for the ability to recognize money. There are picture cards representing paper banknotes in the representational stage that are used for the ability to recognize money. In the abstract stage, images are written in writing (One Hundred Turkish Lira) on paper banknotes (Figure 2). In addition, a reinforcement basket and a tablet were used to watch the video prompting. Figure 2 contains sample materials designed for the ability to read the clock and the ability to recognize money. The materials presented as examples are 2:00 for the ability to read the clock, and One Hundred Turkish Lira for the ability to recognize money.

2.5. Treatment Process

A student with the desired prerequisite skills was determined for the students who participated in the research treatment process, and a pilot study was carried out with this student. No problems were encountered in implementing the programs prepared at the end of the pilot application. After the pilot application, the experimental process consisted of baseline, treatment, follow-up, and generalization sessions. The first researcher carried out all stages of the treatment process of the research.

2.5.1. Probe Sessions

Probe sessions in research are organized under two headings: baseline probe sessions and daily probe sessions. In baseline probe sessions, the first researcher created an environment for the target skills, and the students' behaviors were observed. The assessment was terminated if the students did not react or act within five seconds. Verbal reinforcement was given at the end of each session in response to the student's attention and effort to participate during the application. In the probe sessions, the path was followed as in the baseline sessions.

2.5.2. Treatment Sessions

Within the scope of the research, video prompting presentation and 3-dimensional materials presentation activities presented with the CRA teaching strategy were used separately in teaching telling the time and recognizing money skills. All treatment sessions were carried out individually. Teaching started with the ability to tell the time. The teaching sessions were carried out during the academic year so that the participant students were taken from their classes and in the self-study classes prepared within the scope of the research, distractions were cleared, and all equipment was ready. Teaching sessions continued until students performed 100% correctly on the target skills.

In both teaching practices, the skills taught were carried out three days a week and in two sessions per day. The correct responses given by the students were reinforced in the practice sessions. (e.g., you are perfect, you are great, well done, etc.); when the student provided the incorrect response, the implementer did not respond and ended the assessment by ignoring it. At the end of each session, the student's attention to the practice and the effort to participate was specially reinforced (Figure 3).

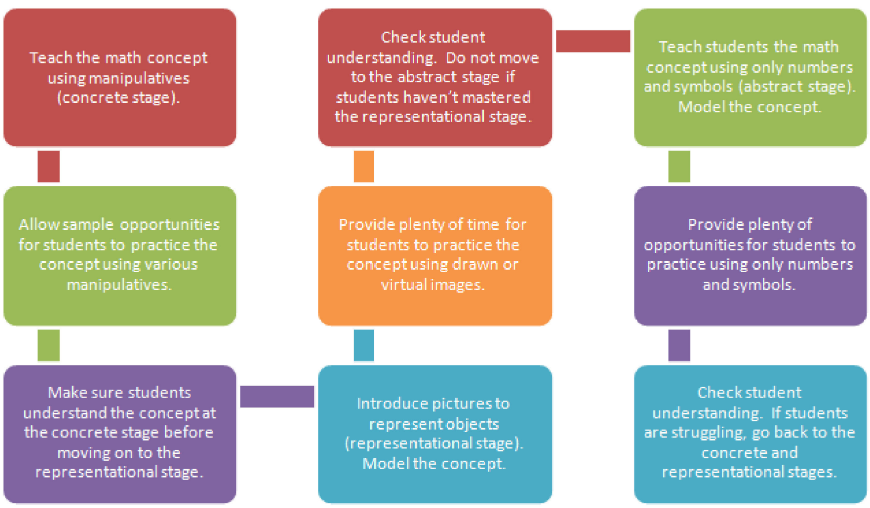

Figure 3. Treatment process of CRA teaching strategy.

Treatment of CRA Teaching Strategy by Video Prompting Presentation

After the end of the probe sessions, the video prompting presentation of the concrete-representational-abstract teaching strategy with the concrete phase started to be implemented individually. In the treatment of this stage, the participant student and the researcher sat side by side. After a short conversation with the student, it was explained to the student what to do in the application. Information was given about how the presentation of the application would be delivered. Then, the student's verbal or body language approval was obtained to start the application. After the approval, the rules of the study were told, and it was stated that if he followed the rules, he could take whatever he wanted from the prize basket at the end of the study.

Before the start of the study, a tablet was placed in front of the student to watch the video prompting. Video prompting was prepared initially, and an adult model was employed. All the steps in the video prompting are designed for modeling, guided application, and independent application, and there is a 15-s pause between each step. All in struction sets in video prompting were placed in front of the student in order (concrete –representational–abstract), and the environment was prepared for instruction. After observing that the student was ready for the study, the video was opened, and the "Watch and Listen" command was given to the student. After the student watched the first step of the concrete stage in video prompting, the video was automatically paused for 15 s, and the student was expected to perform that step. By the end of the teaching phase, with video prompting, the student was expected to be able to apply the taught skill on his own. In this step, the student was given the main instruction of the skill studied and was expected to say it independently. The session was terminated when the students independently reached the results of all the processes in the independent practices step, and the attendance data was taken at the end of the teaching. The representational stage was not passed until the student succeeded in the concrete stage at 100%. The assessment did not pass to the abstract stage without achieving 100% success in the representational stage.

Treatment of CRA Teaching Strategy by Presentation with 3D Materials

After the probe sessions ended, the presentation of the CRA teaching strategy using 3D materials began individually. During the treatment of this stage, the participant student and the researcher sat opposite each other. All distractions were removed, and the student was asked if he needed anything by having a short chat. Information was given about the presentation of the application to be made. Then, the student's verbal or body language approval was obtained to start the application. After the approval, the rules of the study were told, and it was stated that if he followed the rules, he could take whatever he wanted from the prize basket at the end of the study.

After the motivation is completed, the application starts by using 3D materials and modeling. Since the first stage of the CRA teaching strategy is the concrete stage, the teaching was carried out with concrete objects that the student can move. The concrete stage continued with guided and independent practice, and the representational stage was not passed without achieving 100% success. It has not been passed to the abstract stage without achieving 100% success in the representational stage. The session was terminated when the students independently reached the results of all the processes in the independent practices step, and the attendance data were taken at the end of the teaching.

2.5.3. Follow-Up Sessions

The follow-up sessions were organized for each student in the first, third, and fourth weeks after the teaching sessions, similar to the baseline sessions.

2.5.4. Generalization Sessions

The research aimed to find out whether the students performed the skills they acquired through video prompting and presentations of the concrete-representational-abstract teaching strategy with 3D materials in different environments and with different people by applying pre-test & post-test measurements. The pre-test generalization session was held after the baseline sessions, and the post-test generalization session was held after the last probe session. In the generalization sessions, when the students performed the skills at the desired level, they were verbally reinforced at the end of the session in response to their attention to the practice and their effort to participate.

2.6. Data Collection

The research collected four data types: effectiveness, applicability, reliability, and social validity. Efficiency data were collected in separate probe and treatment sessions for video prompting presentation and presentation with 3D materials. The following process was followed in both presentations. Efficiency data were collected based on the responses given to the student after the skill instruction was given to the target behaviors. After the skill instruction was given to the student regarding the target behaviors, the student's reaction was expected. The correct responses given by the student independently were marked as "+" in the registration form, and the number of correct responses was calculated. Incorrect responses and no response given by the student were marked as "-" in the registration form. While collecting data on the skill of "telling the time", students were expected to exhibit the following behaviors, respectively, which were recorded in the data recording form. These are (a) by using the concrete objects to show the exact hours to the student and ask him, "What time is it? Tell me." it was expected for the student to say all exact hours 100% independently, (b) by using the representational objects to show the exact hours to student and ask him "What time is it? Tell me.", it was expected for the student to say all exact hours 100% independently and (c) by using the abstract objects to show the exact hours to student and ask him "What time is it? Tell me.", it was expected for the student to say all exact hours 100% independently.

CRA was used as a teaching strategy while studying the ability to recognize money within the scope of the research. As there are three consecutive phases of the CRA teaching strategy, to confirm that he independently recognizes the banknote used in each phase, "How much is this? The question of "Tell me" was directed to the student. After seeing that he recognized and said money using concrete objects, the teaching continued using representational objects. After succeeding in recognizing money with representational objects, the same process was carried out with abstract objects. For this reason, the same question was used at every stage.

While collecting data on the "recognizing money" skill, students were expected to exhibit the following behaviors, which were recorded in the data recording form. These are (1) showing TRY 5, 10, 20, 50, and 100 using concrete objects and asking, "How much is this? Tell me", 100% independent recognition of all banknotes in daily use (2) showing TRY 5, 10, 20, 50 and 100 using representational objects and asking "How much is this? Tell me", 100% independent recognition of all banknotes in daily use and (3) showing TRY 5, 10, 20, 50 and 100 using abstract objects and asking "How much is this? Tell me", 100% independent recognition of all banknotes in daily use.

While collecting the effectiveness data, the correct and incorrect responses of the students were recorded, and the correct response percentage was calculated. When collecting productivity data, to determine whether the two teaching practices differ in terms of efficiency (a) the number of sessions until the criterion is met, (b) the total teaching time until the criterion is met, (c) the average duration of each teaching session (d) the efficiency of the total number of probe sessions until the criterion is met, and (e) the percentage of incorrect responses in the total probe sessions until the criterion is met were noted.

Inter-observer reliability and application reliability data were collected in 30% of all sessions held throughout the research. The formula "consensus/consensus disagreement × 100" was used in the study to analyze the reliability of data among the observers. Inter-observer reliability data was found to be 100% at all stages. Application reliability was collected by two experts working in special education. The formula [Observed Practitioner Behavior/Planned Practitioner Behavior × 100] was used to calculate the treatment reliability coefficient [50]. The application reliability was found to be %100.

The social validity of the study was determined using the subjective evaluation approach. For this, the interview technique, one of the qualitative research methods, was used. After the application was over, interviews were held with the student's parents and teachers, which lasted between 30 and 60 min. For this purpose, the researchers used an interview form consisting of fifteen semi-structured questions. After the end of the research, the data at the beginning and in the last teaching session were presented separately to the parents and teachers. Then they were asked to evaluate the relevance of the findings. They were asked to evaluate the importance and functionality of the targeted skills, the appropriateness of the methods used in teaching the skill, and the functionality by taking the opinions of the families and teachers on the skills aimed to be taught. In order to collect social validity data, at least one of the families of the participating students was met individually at the school where the treatment process was organized. Before starting the social validity questions, permission was asked from parents to audio-record their answers. After receiving social validity data from parents, social validity questions were also asked to the teachers of the participating students. The interviews were conducted individually. Permission was requested from the beginning of the interview to audio-record the answers. Social validity data were collected by asking interview questions. All interviews to collect social validity data were planned in advance and took place in individual rooms at the school where the research was conducted. In order to collect social validity data, parents and teachers were asked about their thoughts on both presentation methods. Questions were directed toward the favorite aspects of the presentation forms used in the research.

2.7. Analysis of Data

The data obtained in the research were analyzed graphically, and a linear graph was used for this. The student's scores on performing the skill are numbered on the "y" axis as a percentage, between 0–100, and the baseline, treatment, and follow-up data are numbered on the "x" axis and are shown at equal intervals. Social validity data obtained from teachers and families through semi-structured interviews were analyzed using the content analysis technique.

3. Results

This section includes the effectiveness, efficiency, monitoring, and generalization findings of the presentations of the CRA teaching strategy with video prompting and 3D materials in teaching students with developmental retardation to tell the time and recognize money. The 100% comprehension criterion of each skill taught was expected to be met.

3.1. Findings on the Effectiveness of Presentations of CRA Teaching Strategy with Video Prompting and 3D Materials in Teaching the Skills of Telling the Time and Recognizing Money to Salih

The data about Salih is given in Figure 4. When Salih's graph is examined, it is found that Salih does not have the skills (telling the time and recognizing money) at the time of the introductory level sessions. When Salih's practice sessions are examined, it is seen that there is an increase in the targeted skills in the teaching sessions offered with both teaching methods. Six sessions were held at the concrete stage, seven at the representational stage, and eight at the abstract stage until the CRA teaching strategy met the 100% criterion in presentation with 3D materials for teaching the skill of telling the time. Five sessions were held at the concrete stage, seven at the representational stage, and eight at the abstract stage until the CRA teaching strategy met the 100% criterion in the video prompting presentation for teaching the skill of recognizing money.

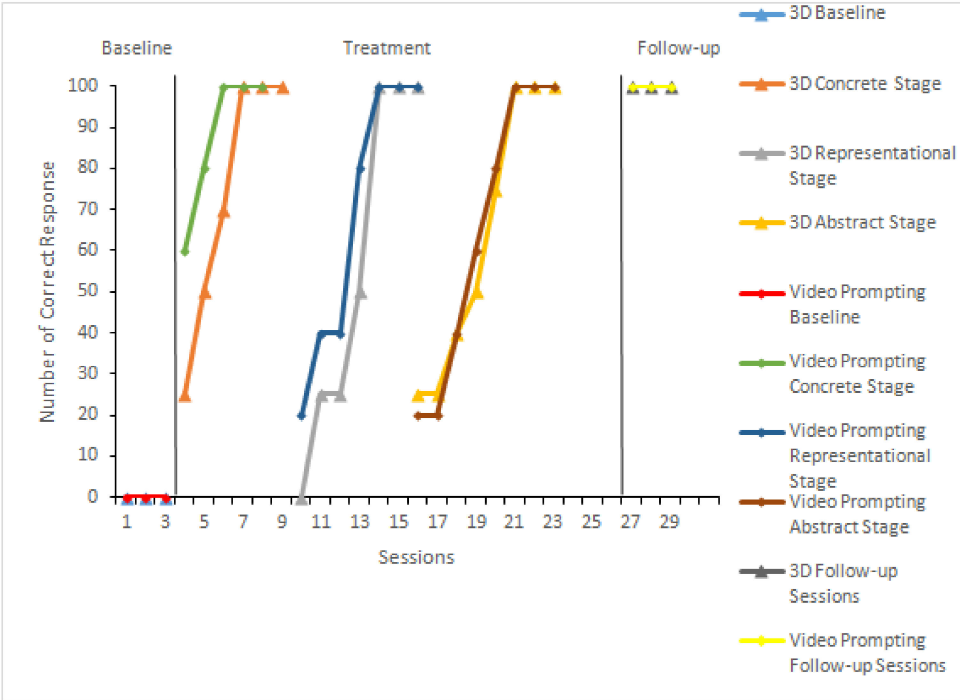

Figure 4. Salih's baseline level, treatment and follow-up phases of CRA teaching strategy with video prompting and presentation practices with 3D materials and learning level of telling the time and recognizing money skills.

According to the findings of Salih, it was concluded that the CRA teachings delivered in applications with both video prompting and 3D materials were effective. However, as seen in Figure 4, the skill acquisition of presentation with 3D materials took place in the 21st session. The desired criterion was reached in the 22nd session, and the application was terminated when stable data were obtained. The monitoring data determined that Salih responded 100% correctly to the questions asked about the skills he acquired in all three monitoring sessions.

3.2. Findings on the Effectiveness of Presentations of CRA Teaching Strategy with Video Prompting and 3D Materials in Teaching the Skills of Telling the Time and Recognizing Money to Muhammed

The data about Muhammed is given in Figure 5. When the graph of Muhammed is examined, it is seen that Muhammed does not have the skills (telling the time and recognizing money) at the time of the introductory level sessions. When the practice sessions of Muhammed are considered, it is seen that there is an increase in the targeted skills in the teaching sessions offered with both teaching methods. Six sessions were held at the concrete stage, eight at the representational stage, and ten at the abstract stage until the CRA teaching strategy met the 100% criterion in the presentation with 3D materials for teaching the skill of telling the time. Seven sessions were held at the concrete stage, eight at the representational stage, and eight at the abstract stage until the CRA teaching strategy met the 100% criterion in the video prompting presentation for teaching the skill of recognizing money.

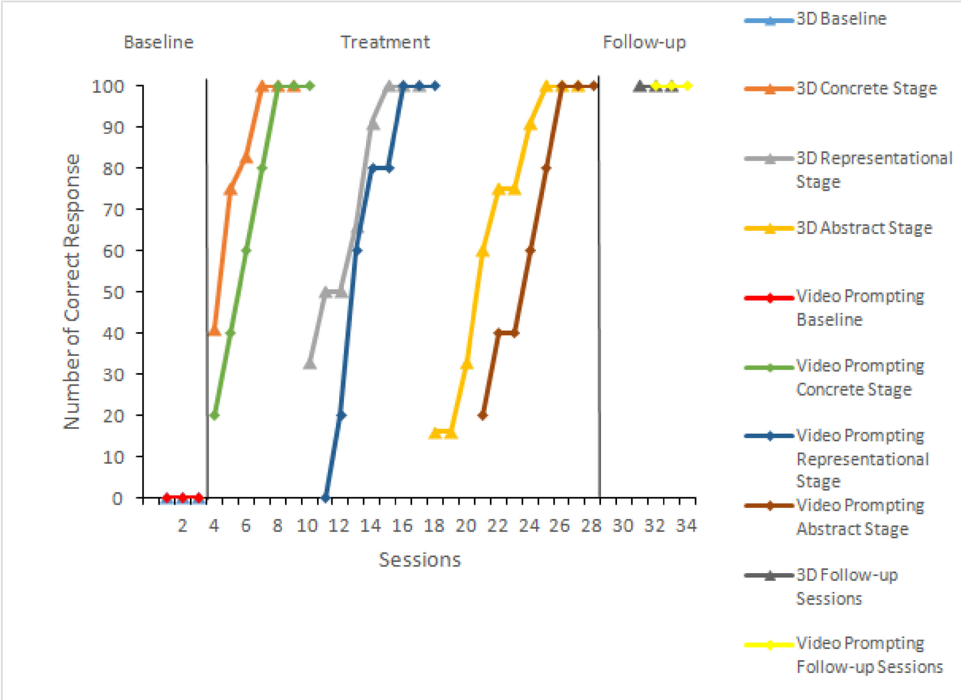

Figure 5. Muhammed's baseline level, treatment and follow-up phases of CRA teaching strategy with video prompting and presentation practices with 3D materials and learning level of telling the time and recognizing money skills.

3.3. Findings on the Effectiveness of Presentations of CRA Teaching Strategy with Video Prompting and 3D Materials in Teaching the Skills of Telling the Time and Recognizing Money to Ege

The data about Ege is given in Figure 6. When the graph of Ege is considered, it is seen that Ege does not have the skills (telling the time and recognizing money) at the time of the introductory level sessions. When Ege's practice sessions are examined, it is revealed that there is an increase in the targeted skills in the teaching sessions offered with both teaching methods.

Five sessions were held at the concrete stage, eight at the representational stage, and eight at the abstract stage until the CRA teaching strategy met the 100% criterion in the presentation with 3D materials for teaching the skill of recognizing money. Eight sessions were held at the concrete stage, nine at the representational stage and nine at the abstract stage until the CRA teaching strategy met the 100% criterion in teaching the time skill with video prompting presentation.

The findings regarding Ege allowed the conclusion that the CRA teachings delivered in applications with both videos prompting and 3D materials were effective. However, as seen in Figure 6, while the skill acquisition of presentation with 3D materials took place in the 21st session, the skill acquisition of the video prompting presentation was achieved in the 26th session, and the application was terminated when stable data were obtained. The monitoring data determined that Ege responded 100% correctly to the questions asked about the skills he acquired in all three monitoring sessions.

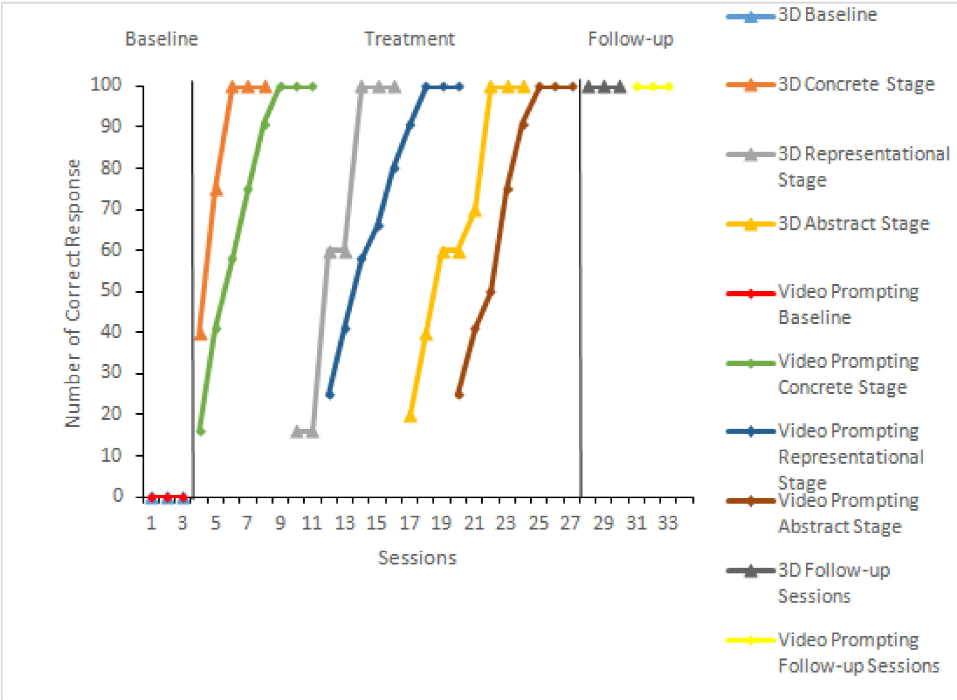

Figure 6. Ege's baseline level, treatment and follow-up phases of CRA teaching strategy with video prompting and presentation practices with 3D materials and learning level of telling the time and recognizing money skills.

3.4. Efficiency Findings

Table 1 shows whether the CRA teaching strategy differs in terms of the efficiency of video prompting and presentation with 3D materials. There are similarities in the number of sessions completed until the teaching takes place, similarities in the total number of attempts to teach different skills and similarities in the number of incorrect responses made until the teaching occurs.

Considering the number of sessions held until the criterion for the functional academic skills taught to Salih is met, it is seen in Table 1 that the CRA teaching strategy presented a total of 21 sessions held with 3D materials and 20 sessions using the video prompting presentation. Considering the number of trials, 252 trials were conducted to present the CRA strategy with 3D materials, while 100 presentations were delivered with video prompting. Among these attempts, the total number of mistakes Salih made was 89 with 3D materials and 29 with video prompting. Teaching the skill of telling the time with 3D materials took 840 min, and 800 min, with 40 min for each session, to teach the skill of recognizing money with video prompting. Considering the number of teaching sessions, the total number of incorrect responses, and the total time spent by Salih until he met the criteria for functional academic skills (telling the time and recognizing money), it can be said that the presentation of the CRA teaching strategy with video prompting is more efficient than its presentation with 3D materials.

Considering the number of sessions carried out until the criterion for the functional academic skills taught to Muhammed is met, it is seen in Table 1 that the CRA teaching strategy presented a total of 24 sessions in the sessions held with 3D materials and 23 sessions in the video prompting presentation. Considering the number of trials, 288 presented the CRA strategy with 3D materials, while 115 presentations were made with video prompting. Among these attempts, the total number of mistakes made by Muhammed is 78 with 3D materials and 38 with video prompting. It took a total of 840 min, 40 min for each session, to teach Muhammad the skill of telling the time, which was performed with 3D materials, and to teach the skill of recognizing money with video prompting, a total of 800 min, each session being 40 min. Considering the number of teaching sessions, the total number of incorrect responses, and the total time spent, until the functional academic skills (telling the time and recognizing money) criteria aimed at Muhammed are met, it can be said that the presentation of the CRA teaching strategy with video prompting is more efficient than its presentation with 3D materials.

Table 1. Efficiency findings in presentation of CRA teaching strategy with video prompting and 3D materials.

Student	Treatment (Presentation)	Number of Sessions	Number of Attempts	Number of Incorrect Responses in Teaching Sessions	Total Teaching Time
Salih	3D (Telling the time)	21	252	89	Each session (40 min)
	Video prompting (Identifying money)	20	100	27	Each session (40 min)
Muhammed	3D (Telling the time)	24	288	78	Each session (40 min)
	Video prompting (Identifying money)	23	115	38	Each session (40 min)
Ege	Video prompting (Telling the time)	26	312	80	Each session (40 min)
	3D (Identifying money)	21	105	28	Each session (40 min)

Considering the number of sessions held until the criteria for functional academic skills taught for Ege are met, it is seen in Table 1 that the CRA teaching strategy presented a total of 26 sessions in the sessions held with 3D materials and 21 sessions in the video prompting presentation. Considering the number of trials, 312 trials were conducted in presenting the CRA strategy with 3D materials, while 105 presentations were delivered with video prompting. Among these trials, while Ege's total number of errors is 80 with 3D materials, it is 28 with video prompting. Teaching the ability to tell the time, carried out with 3D materials, took 840 min, 40 min for each session, and 800 min, 40 min for each session, to teach the skill of recognizing money with video prompting. Considering the number of teaching sessions, the total number of incorrect responses, and the total time spent, it can be said that the presentation of the CRA teaching strategy with video prompting is more efficient than the presentation with 3D materials until the target functional academic skills (telling the time and recognizing money) criteria met.

3.5. Social Validity Data Findings

A social validity form was prepared to collect social validity data from the parents of the participant students and teachers. The social validity forms directed to the parents and teachers are open-ended and semi-structured. After the completion of the treatment process, answers from parents and teachers regarding the validity of the research were collected.

Two teachers and three parents whose social validity data were collected gave a more positive opinion about the video prompting the presentation of the CRA teaching strategy. When parents and teachers were asked whether they saw a significant difference in the ability of participating students to read the clock and recognize money, positive answers were received. In open-ended questions, a parent replied, "We used to ask for the time before, but he did not tell it, now he is telling us the time independently". When asked about teachers' thoughts on the video prompting presentation, one teacher said, "This is the first time I've seen this presentation style. It's a very good presentation. I think it's great convenience and students are more focused and involved." In line with the answers received from parents and teachers about the video prompting presentation, (a) it increases the student's motivation and attention, (b) prevents time loss, (c) does not allow the student to get bored, (d) ensures the student's enjoyment, (e) the skill is less likely to be forgotten, and f) it is very suitable for distance education.

When parents and teachers were asked about the applications performed with 3D material presentation, positive answers were received again, but less positive answers were obtained compared to video prompting. Families and teachers stated that the form of presentation delivered with 3D materials has less advantages compared to the application with video prompting. Especially in the open-ended questions asked to the teachers, their thoughts about the presentation of 3D material included "There are always 3D materials in our school. This allows us to practice with less preparation. This is the advantage of teaching with 3D materials.". When asked about 3D materials, one of the parents said, "We don't have as many materials at home as school. This is sad. But it is possible to reinforce practice with 3D materials at home. Sometimes, even if my child is bored, I encourage him to focus.". Their favorite aspects in 3D material presentation are: (a) the setting of the environment is simple, (b) the teaching is delivered with the material at hand, and (c) it does not require preliminary preparation and technological support. The students' teachers stated that both presentation techniques (3D materials and video prompt) effectively implemented the teacher CRA teaching strategy. The parents of the students also stated that the video prompting presentation was effective.

4. Discussion

In this section, the findings obtained in line with the research aims are discussed among themselves and by comparing them with the literature.

Within the scope of the research, it was determined that the CRA teaching strategy effectively taught functional academic skills (the skills of telling the time and recognizing money) to the student with developmental retardation in both presentation forms (video prompting and 3D materials). When the literature was examined, no research was found in which functional academic skills such as reading the time and recognizing money were used together with video prompting and 3D materials presentations to implement the CRA teaching strategy for individuals with developmental retardation. The findings from this research show parallelism with the results obtained in the literature for the CRA teaching strategy, both for video prompting [53,54] and 3D materials [34,48,55] separately. It is important that the video content and the environments where the videos are presented attract the attention of the students, that their motivation to work increases, the target behavior and the sub-steps that make up this behavior are described in a very clear and concrete way, the students are allowed to choose during the application, the video content meets the needs of the student, and the student is informed about it. These factors make video prompting more effective. It is thought that these factors will have enabled the student to participate in the practice sessions more willingly, dynamically, and determinedly, and may have been reflected in the results. During the video prompting, participants looked at the materials viewed in the video and then looked at the same materials in the environment [22]. Factors such as the setting of an environment that attracts the attention of students and increases their motivation towards work, and the fact that the materials used during the application attract the attention of the students and are suitable for their developmental characteristics make the 3D materials strategy effective. It is thought that these factors will have enabled the student to participate in the practice sessions willingly, dynamically, and determinedly and may have been reflected in the results.

Considering the findings of the research sessions, it was seen that all three students continued their skills of telling the time and recognizing money in the second, third, and fourth weeks after the end of the education. These findings are consistent with the research findings in the literature [48]. It is thought that the reason for the similarity between the literature and the findings of the follow-up sessions obtained from this study is due to the presentations of the skills taught and the CRA method used. It is thought that the CRA strategy with video prompting and the presentation of 3D materials supports the interests and wishes of the students. This increases students' motivation for study and the acquisition and sustainability of the targeted skills. In addition, it is thought that the ability of students to use the skills they have acquired in daily life may have increased the probability of the skills being permanent. Thus, it can be said that the skills learned are preserved in the following processes.

According to the study's other finding, it was observed that the functional academic skills acquired with both presentations of the CRA teaching strategy could be generalized to different environments and people. These findings are consistent with the research findings in the literature [48]. It comes to mind that the reason for the similarity between the literature and the findings of the generalization sessions obtained from this study may be due to the presentation of the taught functional academic skills and the CRA teaching strategy.

Within the scope of the research, when both presentation forms (video prompting and 3D materials) of the CRA teaching strategy were compared in terms of efficiency in helping students with developmental retardation gain functional academic skills (the ability to tell the time and recognize money), it has been concluded that the video prompting presentation form is more efficient than the 3D materials presentation form. When the literature is examined, no research has been found in which both presentation styles (video prompting and 3D materials) of the CRA teaching strategy are used and compared in terms of efficiency. However, studies were found in which the efficiency of the CRA method for gaining functional academic skills was determined separately from other methods. In the literature, it is seen that there are studies [28,33,34,38,39,54] showing that the CRA teaching strategy is effective against other teaching methods and strategies. In this study, the video prompting presentation of the CRA teaching strategy is more efficient than the presentation of 3D materials can be explained as follows. Considering the number of attempts and the duration until the completion of the instruction, it was determined that the CRA teaching strategy presented with video prompting was more efficient. Students are better able to focus on the video prompting presentation. It is thought that the student's interest and focus on the video in the experiments with the video prompting presentation caused them to understand better.

In the study, social validity data were obtained by taking the opinions of parents and teachers. Examining these data, it was determined that the parents and teachers included in the study reported positive opinions about the research and stated that they were very satisfied with acquiring functional academic skills. This finding is consistent with other research findings in the literature [38,48]. The positive opinions and satisfaction of both parents and teachers about the acquisition of functional academic skills can be explained by how important the skills of recognizing the money earned and telling the time are in the lives of individuals. It can be said that knowing money and telling the time are among the skills that individuals will encounter in their daily lives at every point of their life. The use of video prompting presentations can be a useful presentation method for teachers and families. Using video prompting for instruction can free the teacher up for more intrusive prompting for specific students rather than attending to everyone at once [56].

Additionally, teachers can use technology to the benefit of each student and allow students to repeat teacher instruction until they achieve skill mastery. Using technology-based intervention, teachers have the flexibility of individualizing instruction for each student and providing each student with individualized help during the learning process [54]. These skills are also closely related to the academic success of the student. All of the activities pertaining to daily life, such as clock reading, time management, understanding the value of money, and counting all benefit from the skills brought by basic functional academic skills. Therefore, it is believed that these skills will help students gain independence in daily life and learn advanced functional academic skills.

5. Conclusions

The educational benefits of effective strategies will create opportunities for success and ensure learning for all students, including students with special needs. Teaching students with diverse needs and strengths with effective strategies offer success in many academic areas.

The video prompting presentation, which is more technological and functional, is an ideal presentation method in distance education. It is a presentation method that differentiates and attracts more attention for students. It can be a form of presentation that is sustainable and can establish a connection between the student and today's technology. Once the video prompting presentation is prepared, it can be used multiple times both at school and at home to reinforce the student's teaching. The video prompting presentation prepared in accordance with the instruction can benefit the student and family in many ways. As a result, the video prompting presentation performed with the CRA teaching strategy has the same effectiveness as the CRA teaching with the 3D material teaching technique that has been used for years. However, when examined in terms of efficiency, the video prompting presentation was found to be a more efficient method.

In line with these results, the following recommendations can be made for practice and further research: (a) providing training to teachers, families and experts on how to apply video prompting can enable the application of video prompting in teaching functional academic skills to students with developmental retardation; (b) the effectiveness and efficiency of using presentation techniques with video prompting and 3D materials can be examined in teaching different subjects apart from teaching functional academic skills to individuals with developmental retardation; (c) in teaching functional academic skills, these two presentation techniques can be applied to individuals with different diagnoses of inadequacy, or their effectiveness and efficiency can be compared by blending them with different teaching methods.

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