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THE EFFECTIVENESS OF FIXED-TIME INTERVAL INSTRUCTION IN TEACHING PATTERN FORMATION SKILLS TO STUDENTS WITH MILD INTELLECTUAL DISABILITIES

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ABSTRACT

Consistent learning experiences provided to students with intellectual disabilities contribute to the permanence of their learning. Functional academic skills are essential for students to acquire in order to lead independent lives. The skill of pattern formation, which holds a significant place among early mathematical skills, is crucial in minimizing the challenges already faced by students with intellectual disabilities while learning mathematical concepts, given that these students encounter numerous difficulties in learning mathematics. "Due to its significance as a skill that needs to be acquired in the preschool special education curriculum, this skill holds importance for students with intellectual disabilities within the group of individuals with special needs. "The aim of this study is to investigate the effectiveness of fixed-time interval instruction in teaching pattern formation skills to students with mild intellectual disabilities. The concept of patterns, which falls within the scope of mathematical skills, is encountered in various aspects of daily life. This study was conducted with three students, aged 6-7, consisting of one male and two females. The research design utilized for this study is the single-subject research model, employing multiple baseline model across participants design.". The independent variable of the study is the presentation of pattern formation skills using the fixed-time interval instruction method, and the dependent variable is the highest level of accuracy achieved in completing target patterns. In the study, data on social validity, reliability, and effectiveness were collected. Linear graphs, a graphical analysis technique, were employed to analyze effectiveness and reliability data, while the analysis of social validity data was conducted qualitatively. As a result of the research, it was observed that the fixed-time interval instruction method was effective in teaching the concept of patterns to preschool children with mild intellectual disabilities, and students demonstrated success in the follow-up data collected in the 1st, 2nd, and 4th weeks. During the generalization sessions, it was also observed that students could generalize their pattern formation skills to different settings using colored covers. Parents and teachers reported that they observed success in participants' efforts related to the pattern concept

Keywords: Pattern formation skill, intellectual disability, fixed-time interval instruction.

INTRODUCTION

The primary objective of education for every individual is to enable them to live independently. Providing consistent learning experiences to students with intellectual disabilities ensures the permanence of their learning. Functional academic skills are essential for students to acquire in order to lead independent lives. Additionally, these students need to acquire functional academic skills to prepare them for independent living (Snell ve Brown, 2000). The concept of patterns, which falls within the scope of mathematical skills, is encountered in various aspects of daily life. There is a rule and order in everyday routines, the arrangement of sunflowers in nature, the rising and setting of the sun, and even the arrangement of pine cones on trees. These patterns that we encounter in daily life are crucial for understanding mathematical concepts. Achievements such as pattern formation, continuation, and recognition also serve as fundamental skills for perceiving mathematical relationships, making generalizations, and fostering mathematical thinking (Burns, 2000). According to Souviney (1994), in the field of mathematics, the skill of pattern formation, which is considered an early mathematical skill, involves systematically and orderly arranging and structuring objects, symbols, geometric shapes, sounds, and actions, and defining them based on certain rules and relationships. (Souviney, 1994' ten akt., Tanışlı ve Özdaş, 2009: Guerrero ve Rivera, 2002'dan akt.; Tanışlı ve Özdaş, 2009). The skill of pattern formation, which holds a significant place among early mathematical skills, is of paramount importance for students with intellectual disabilities, as they already face numerous challenges when learning mathematical concepts. Therefore, it plays a crucial role in minimizing these difficulties (Papic, 2007). Due to the necessity of acquiring this skill in the preschool special education curriculum, it also holds significance for students with intellectual disabilities within the group of individuals with special needs.

The content of education programs designed for individuals with intellectual disabilities is created with the aim of equipping them with the skills necessary for independent living in society. These skills are classified into social, language and communication, self-care, motor, and academic skills. Individuals who acquire these skills will be able to participate in social life without depending on others and lead their lives independently (Cavkaytar, 2000). Functional academic skills are fundamental skills required for an individual to live independently in society. Students who acquire functional academic skills excel in their school life and can also acquire essential skills for daily life, such as reading, recognizing currency, basic arithmetic, academic proficiency, and fundamental operations (Erbaş, 2008; Karabulut ve Yıkmış, 2010).

It has been observed that the skill of pattern formation, which is one of the fundamental academic skills, enhances mathematical abilities such as sequencing, calculation, and arrangement. It also fosters the understanding of mathematical knowledge, concepts, and relationships, as well as reasoning, communication, association, and problem-solving skills (Çiftçi-Tekinarslan, 2012; Derby, 2013; Sazak-Pınar ve Kocabıyık 2014). Tanışlı, Köse, and Camcı (2017) stated in their research that the development of verification and generalization patterns should be supported from early childhood, and these patterns should be included among the fundamental objectives in mathematics education. According to Papic and colleagues (2011), they have stated

that pattern formation is as important as the development of numerical knowledge and numerical understanding. They have also noted that this skill will be acquired through participation in early mathematics education. Furthermore, they emphasized the significance of pattern formation skills in abstracting certain mathematical relationships and ideas and in developing mathematical reasoning at a young age. Although the assessment inventory for early mathematical patterns applied to 53 students in two preschools over a six-month period was successful in evaluating repeated and spatial pattern skills before and immediately after the implementation process, it was concluded that pattern examples need to be simplified and involve fewer (Papic, 2007).

The skill of pattern formation plays a significant role in understanding mathematical knowledge and concepts, perceiving mathematical relationships, and enhancing children's abilities in sequencing, calculation, and arrangement. Additionally, pattern formation skills substantially influence the development of communication, reasoning, problem-solving, and associational skills (Tanışlı ve Özdaş, 2009; Steen, 1998). In the literature, it is observed that errorless teaching methods are frequently used in the instruction of single-step and chained skills for students with intellectual disabilities (Tekin-İftar ve Kırcaali-İftar, 2020). Schuster (1998) conducted a review of 20 articles from the literature and concluded that the Fixed-Time Interval Instruction Method (FTIIM) is effective in teaching various chained skills to students with intellectual disabilities. Basic mathematical skills were categorized into single-step skills such as mental addition and multiplication tables, and chained skills such as addition, subtraction, multiplication, and division (Snell ve Brown, 2000; Wolery, Ault ve Doyle, 1992). In the literature, there is a limited number of studies on the instruction of pattern formation skills, and there are very few studies focused on teaching the concept of patterns to students with intellectual disabilities. Research conducted in Turkey does not appear to include a study on the effectiveness of the FTIIM in teaching the pattern concept to preschool children with mild intellectual disabilities. Studies related to teaching pattern skills typically involve participants who are of primary school age. Therefore, this study is planned to contribute to the existing body of research and future studies in this area, with the aim of increasing the research efforts in this field. The aim of this research is to investigate the effectiveness of Fixed-Time Interval Instruction Method (FTIIM), which is one of the evidence-based practices, on the pattern formation skills of preschool children with mild intellectual disabilities. In pursuit of this objective, the following questions will be addressed.

1) Is the FTIIM effective in developing the pattern formation skills of preschool children with mild intellectual disabilities using objects of different shapes and colors?,

2) Do the acquired skills remain preserved one, two, and four weeks after the instructional sessions have ended?

3) Is FTIIM effective in generalizing the pattern formation skills to different objects and environments?

METHOD

The Research Model

In this study, which aims to determine the effectiveness of FTIIM in teaching the pattern concept to individuals diagnosed with mild intellectual disabilities, a single-case research design using the multiple baseline across participants model, one of the single-subject research models, was employed. The research obtained ethical approval from the Ethics Committee for Social and Human Sciences Research of Gaziosmanpaşa University on January 5, 2023.

Participants

This study, aiming to determine the effectiveness of FTIIM in teaching the pattern concept to preschool children diagnosed with mild intellectual disabilities, was conducted with three inclusive education students. The study commenced with obtaining baseline data from children deemed suitable for the research. Written permission was obtained from the Tokat Provincial Directorate of National Education and the participants' families to ensure the participation of the participants in this study. The participants' real names were not used, and pseudonyms were assigned. All three participants, named Ege, Buse, and Feyza, are preschool children diagnosed with mild intellectual disabilities. They are all receiving education as inclusive students in the preschool class and attend a special education and rehabilitation center one day a week. Determination of whether the participants possessed prerequisite skills was made by examining the development reports filled out by their teachers. The prerequisite skills that participants should possess in this research are as follows: a) having visual perceptual abilities, b) having auditory perceptual abilities, c) using fine motor skills, d) coordinating hand-eye movements, e) not having challenging behaviors, f) recognizing primary colors, g) recognizing objects, h) recognizing shapes, i) having imitation skills, j) being able to follow instructions.

Feyza, one of the female participants, is 80 months old and attends preschool on weekdays. She receives education one day a week at a special education and rehabilitation center. Feyza's gross motor development is similar to her peers, but she lags behind her peers in terms of cutting and coloring activities. She can not possess hand-eye coordination skills. She has a speech disorder, and her vocabulary is limited. She does not establish eye contact while speaking.

Ege, who is 70 months old, is a male student in a preschool class at a school. He receives education one day a week at a special education and rehabilitation center. He has a speech disorder. He can perform fine motor activities that require hand-eye coordination, such as cutting and creating new shapes. He can describe the location of objects in space, recognize colors and shapes, and identify numbers from 1 to 10.

A female participant named Buse, who is 73 months old, and attends preschool education, can perform fine motor activities that require hand-eye coordination, such as cutting and creating new shapes. She can do

activities that require balance and can dance to music and rhythm. She can express positive and negative feelings and thoughts, respects her own and others' rights, and waits her turn to speak. She can describe the location of objects in space, recognize colors, shapes, and numbers from 1 to 10.

The practitioner (the first author) holds a bachelor's degree in preschool education and is currently pursuing a master's degree in special education. Additionally, she serve as a school principal in a primary school affiliated with the Ministry of National Education (MEB). She has twenty years of professional experience, with five years in teaching and fifteen years in administrative roles.

The Environment

The study was conducted in a classroom outside of each participant's regular attendance classroom, with only the participant and the practitioner present. The classroom where the study was conducted has a laminate flooring, but there is also a carpeted area where the child can play while sitting. The classroom is equipped with appropriately sized tables and chairs for preschool children. There are colorful cushions and cabinets for storing classroom materials. The classroom environment is well-lit and has a sun-exposed facade. There is a mirror hanging on one of the classroom walls, along with educational materials suitable for children.

Materials

In this study, which investigated the effectiveness of FTIIM in teaching pattern formation skills to students with mild intellectual disabilities, a pattern board with ten holes was used for arranging colored pom-poms and materials (Figure 1). The researcher initially began the study using a pattern board that was approximately 80 cm long and had ten holes, with approximately 3 cm between each hole and a depth of 2 cm. During the course of the study, the researcher observed that the students were having difficulty with the triple pattern. Therefore, it was decided that practicing pattern skills on a flat surface without this material, where the children could work on a surface that was close to each other and had less depth, would facilitate learning pattern skills. Therefore, after the initiation of teaching the triple pattern in the study, a new surface was designed with a length of 50 cm, holes spaced 1 cm apart, and a depth of 0.5 cm. It was concluded that the initially created material had a negative impact on the participants' perception of understanding the pattern's rule and hindered their perception of continuity. During the study, video cameras and external memory were used to collect reliability data between sessions. Colored pom-poms were used in the baseline, teaching, and probe sessions. In the generalization sessions, Legos consisting of colors and geometric shapes, pom-poms, and colored bottle caps were used to determine whether the skills were acquired or not. The participants' performances were recorded on data collection forms for probe, follow-up, generalization, and teaching sessions.

Figure 1. Pattern board

Dependent Variable

In educational research, the selection of dependent variables is of paramount importance. The dependent variable in our study is the skill of pattern formation, a crucial cognitive ability that is fundamental to various aspects of learning and development. This article delves into the intricate details of pattern formation skills, with a particular focus on the study's target behaviors, which revolve around the proficiency in creating patterns using a diverse array of colors and objects. These patterns, at their core, comprise triples, quadruples, and quintuples of colors, showcasing the richness and complexity of the construct under investigation. Pattern formation skill is a multifaceted concept that plays a pivotal role in the field of education. At its essence, this skill entails the capacity to organize elements systematically to create coherent and aesthetically pleasing arrangements. In our study, we hone in on the specific facets of pattern formation that involve the use of colors and objects. Within the context of our study, each pattern unit comprises a combination of colors. These units vary in complexity, with participants tasked to create triples (combinations of three colors), quadruples (combinations of four colors), and quintuples (combinations of five colors). This hierarchical structure allows us to assess participants' pattern formation skills across a spectrum of difficulty levels, providing valuable insights into their cognitive capabilities and developmental progress.

Independent Variable

The independent variable of the study is FTIIM. FTIIM is a commonly preferred and effective teaching method, especially for individuals with different age groups and various types of disabilities, including mild, moderate, and severe intellectual disabilities, autism, learning difficulties, visual and hearing impairments. FTIIM is a method that does not require extensive preparation, has a short implementation duration, is easy to apply, has a low margin of error during the process, and allows for the reinforcement of what students have learned. Moreover, it promotes teacher-student interaction, which is why it is frequently chosen as a preferred method. (Tekin-İftar, Kırcaali-İftar, 2020). FTIIM is implemented as zero-second delay and fixed-time delay trials. (Wolery ve Gast,; Wolery ve diğ.den akt. Tekin-İftar ve Kırcaali-İftar, 2020).

General Process

Before starting the research, pilot implementation sessions were conducted with a participant who had received a diagnosis of mild intellectual disability and had similar characteristics to the participants. In the pilot implementation, it was observed that the materials to be used in the instructional sessions were suitable for their purpose. Throughout the experiment, assessment sessions (baseline assessment and daily assessment sessions), implementation, monitoring, and generalization sessions were organized. The researcher conducted the research process in a classroom environment where participants attended regular education schools and where one-on-one sessions could be held. During the implementation period, to eliminate potential threats to internal validity, participants' families, teachers, and teachers at the rehabilitation center were instructed not to engage in any activities related to the target behavior. The time elapsed between the fading pattern skill and instructional sessions was extended, and assessment sessions conducted after the instructional sessions were scheduled for the following day to account for temporal effects.

Experimental Procedure

The researcher provided the necessary conditions such as arranging the environment and preparing the materials for instructional sessions and assessment sessions. The instructional sessions related to the target skill to be acquired in the research were conducted in the participants' natural classroom environments. The baseline phase was conducted repeatedly for a minimum of three consecutive phases until stable data were obtained. Controlled baseline phase arrangements were implemented in all sessions. In the baseline phase, pom-poms consisting of three different colors were used. The researcher sequentially arranged blue, yellow, and red pom-poms to create the first pattern sequence. For the second pattern sequence, the researcher placed the blue pom-pom as the initial color. Then, the participant was asked, "What color is this?" for each pom-pom individually, and after asking about the color of the last pom-pom, the question, "What pom-pom will come next?" was posed. In this way, three trials were conducted in each session. Daily probe sessions were conducted similarly to the baseline phases, occurring 15 minutes after the intervetion sessions. When a 100% accuracy rate was achieved in all three participants for five consecutive probe sessions, the probe sessions were initiated the day after the intervetion sessions in order to fade the cue. Probe sessions were conducted daily for each student, consisting of five trials. A 4-second intertrial interval was provided between trials.

The controlled baseline probe session continued until stable data were obtained for at least three consecutive sessions. Controlled baseline phase arrangements were implemented in all probe sessions. In the baseline and probe sessions, the practitioner received assistance from a special education teacher. In the baseline probe session, the first session involved two-colored pompoms, the second session involved three-colored pompoms, and the third session involved four-colored pompoms.

Daily probe sessions were conducted 15 minutes after the teaching sessions, similar to the baseline probe sessions. After making the necessary preparations, the researcher asked, "Are you ready? We are going to work on the pattern concept today," directing the student's attention to the researcher. When the student responded positively, the probe session began. The researcher sequentially arranged blue, yellow, and red pompoms to create the first pattern sequence, and for the second pattern sequence, the researcher placed a blue pompom. Then, the researcher asked the student, "What color is this?" for each pompom individually, and when they reached the last pompom, they asked, "What pompom comes next?" In this way, three trials were conducted in each session, with the order of the pompoms changing in each trial. A 4-second wait was provided for the student to respond. If the student gave the correct answer, a plus (+) sign was marked in the chart, and after waiting for 4 seconds and when the time was up, the next trial began. Although no reinforcement was provided for the correct answers, verbal reinforcements such as "Thank you for doing the activity with me," "You're great," and "Well done" were used to encourage participation. Error corrections were not made if the student gave incorrect answers or did not respond during the probe sessions. The sessions were recorded by an assistant who observed the researcher and marked them on the Implementation Reliability Form prepared for probe session implementation reliability. During the fading process, the time interval between the instructional session and the probe session was increased in accordance with time-based fading principles, and participant responses were recorded.

Multiple probes were conducted an equal number of times for all participants. Following the completion of the intervential session for the first participant, a multiple probe was conducted with all three participants. Once the intervential sessions for the second participant, Buse, were completed, another multiple probe was administered with all participants, followed by commencing intervential sessions with the third participant. When the criterion was met with all three participants, a final multiple probe was conducted with all of them.

Intervential Sessions

In single-case research, controlled baseline sessions were conducted, and after obtaining stable data across three sessions, interval sessions were initiated with the aim of teaching the targeted skill. Daily baseline sessions were conducted before the interval sessions. In this study, the FTIIM (Pattern Concept Teaching) was employed to teach the concept of patterns. FTIIM was implemented in two forms: sessions with zero-second delay and sessions with a four-second delay. After achieving stable data in baseline measurements, instructional sessions were conducted using the zero-second delay teaching method. Instruction continued until a one hundred percent success rate was achieved with the zero-second delay method. Subsequent instructional sessions were conducted with a four-second delay teaching method. In each session, five trials were conducted with a four-second intertrial interval. Initially, two colors were used, followed by three, four, and five-color pom-poms. Daily check sessions were terminated when participants demonstrated performance meeting the criterion in at least three consecutive sessions. The researcher and the participant sit side by side. The researcher says to the participant, "Today, we will work on the concept of patterns together. Are you ready?" When the participant

responds positively, interval sessions begin. The researcher arranges two pattern cores consisting of pom-poms with two colors, specifying them as yellow and red. From the second pattern sequence, the researcher places a yellow pom-pom and leaves out the red one. The researcher, together with the participant, verbally states the colors of each pom-pom one by one, saying, "yellow, red, yellow, red," and then asks, "Which pom-pom should we place now?" and immediately provides a verbal and demonstrative cue, saying "red." Subsequently, transitioning to three-color patterns, the positions of colors were continuously changed, and in each session, they worked with five trials. The researcher, in the following sessions, provided instructions in the same manner with four and five-color pom-poms. The zero-second delay interval sessions continued until individually achieving a 100% accuracy rate for each of the three participants. Afterward, the researcher initiated the four-second delay interval sessions, saying, "We will work on the concept of patterns, are you ready?" When the participant responded affirmatively, interval sessions began. The researcher arranged pom-poms with three colors, specifying them as yellow, blue, and red, to create the first pattern sequence. Then, from the second pattern sequence, the researcher placed yellow and blue pom-poms and omitted the red one. The researcher, together with the participant, verbally stated the colors of each pom-pom one by one, saying, "yellow, blue, red, yellow, blue," and then asked, "Which pom-pom should we place now?" and waited for four seconds. Correct responses from the participants before the cue were reinforced with phrases like "Well done, great job." If a participant provided an incorrect answer before the cue or did not respond, the researcher provided the correct answer and moved on to the next trial. In this manner, with three colors continuously changing positions, they worked with five trials in each session. In the subsequent sessions with four and five-color pom-poms, the researcher provided instructions in the same manner.

After all trials were completed, reinforcement was provided, encouraging further participation with phrases like "You did a great job working with me today. Thank you". The instructional sessions were conducted on weekdays (Monday, Tuesday, Wednesday, Thursday, Friday) at specific times (09:30-12:00) in the participants' own schools

The Follow-Up And Generalization Sessions

The follow-up sessions were conducted in the 1st, 2nd, and 4th weeks with the aim of assessing whether the participants were still exhibiting the acquired behavior. The follow-up sessions were implemented in the same manner as the baseline sessions. The researcher did not intervene in any way. To investigate the generalization effects of FTIIM in pattern teaching, generalization exercises were conducted within the same session, across different settings (a different classroom or location), and with different materials. Generalization sessions were conducted in rehabilitation centers and participants' homes, which were different from the schools where the instructional sessions took place. Pattern exercises were carried out using colored lids and pom-poms with intermediate colors.

Data Collection

In this research, three types of data were collected, reliability (intervention reliability and inter-rater reliability), effectiveness, and social validity. Three types of data collection instruments were used: the Probe Session Intervention Reliability Data Collection Form for probe sessions, social validity data forms for teachers, parents, and participants, and the intervention session intervention reliability data collection form for intervention sessions. Effectiveness data in this research, consisting of baseline, daily probe sessions, and collective probe sessions, and follow-up and generalization sessions, were collected using the probe session data collection form since the intervention was the same. The instructional session data recording form was used for intervention sessions. Two types of reliability data were obtained in the research, which were inter-rater reliability and intervention reliability. The researcher created the probe and intervention session application reliability forms with expert opinion and collected inter-rater and application reliability data using these form.

In the research, Social Validity Question Forms were developed for the participants' parents, teachers, and the participants themselves in relation to the pattern concept that was aimed to be taught. When creating the social validity forms, the researcher sought input from the thesis advisor, preschool, and special education teachers. The Social Validity Form for Parents consists of six open-ended questions and one question to determine parental educational background. The Social Validity Form for Teachers includes six open-ended questions and one question to identify the teacher's field of expertise, related to the target skills (pattern concept) and the SBSÖY used in teaching these skills. The Social Validity Form for Participants consists of five open-ended questions. The researcher posed these questions to the children individually in their classroom environment and recorded their responses. Participants' mothers were coded as A1, A2, A3, and teachers were coded as Ö1, Ö2, and Ö3.

Data Analysis

Inter-rater reliability data was collected by observing 30% of randomly selected sessions by two preschool teachers from among all sessions. To analyze the inter-rater reliability data, the formula "agreement / (agreement + disagreement) x 100" (Tekin-İftar, 2018) was used.

FINDINGS

The Effectiveness of FTIIM on the Pattern Formation Skills of Feyza, Buse, and Ege

For Feyza, baseline data were collected for three consecutive sessions before using FTIIM (Figure 2). During baseline data collection, since Feyza demonstrated success with binary patterns, intervention sessions began with triple patterns. Six sessions were dedicated to triple patterns, five sessions to quadruple patterns, and three sessions to quintuple patterns. Feyza faced the most difficulty when learning triple patterns. However, once she understood the logic of the triple pattern, she found it easier to comprehend the other patterns. Baseline data for triple patterns were collected in the second session, and for quadruple patterns in the third session. Unfortunately, Feyza couldn't create patterns during these sessions. Intervention sessions began with triple

patterns, and after the first intervention session, a probe session was conducted. However, during the probe session, Feyza couldn't create the pattern. She struggled with triple patterns for three consecutive sessions but eventually mastered them in the following three sessions. After the 7th and 8th instructional sessions, successful probe sessions were conducted before the next instructional session, not immediately after the instructional session, and a 4-second delay FTIIM was implemented. In the 10th session, quadruple patterns were introduced. Although she couldn't succeed in the 10th and 11th sessions with quadruple patterns, she learned them in the 12th, 13th, and 14th sessions. Subsequently, in the 15th, 16th, and 17th sessions, she performed quintuple patterns effortlessly. In the 18th, 19th, and 20th sessions, collective probe data were collected from all three participants. A total of 17 sessions were conducted with Feyza, consisting of the baseline session, the 3rd baseline session, and 14 intervention sessions.

For Buse, at the baseline phase, binary patterns were worked on in the 1st session, triple patterns in the 2nd session, and quadruple patterns in the 3rd session. During the baseline sessions, Buse could perform binary patterns effortlessly but struggled with triple and quadruple patterns. Consequently, intervention sessions with Buse began with triple patterns. Seven sessions focused on triple patterns, three sessions on quadruple patterns, and one session on quintuple patterns. Buse encountered the most difficulty with triple patterns and only grasped them after four sessions. Afterward, she successfully performed triple patterns for three consecutive sessions. Once she understood triple patterns, probe sessions began on the day before the intervention sessions. Buse had no difficulty with quadruple and quintuple patterns. Upon completing the intervention sessions, collective probe data were collected from all three participants in the 34th, 35th, and 36th sessions. In total, 16 sessions were conducted with Buse, including 3 baseline sessions and 13 intervention sessions.

For Ege, baseline data were collected for three sessions, and it was observed that Ege was successful with binary patterns but unsuccessful with triple and quadruple patterns. Consequently, intervention sessions with Ege began with triple patterns. Two sessions focused on triple patterns, three sessions on quadruple patterns, and three sessions on quintuple patterns. Ege quickly learned the patterns as he had grasped the logic of patterns during baseline and multiple probe sessions. He also performed successfully in generalization and follow-up sessions. In total, 11 sessions were conducted with Ege, including 3 baseline sessions, 2 triple pattern sessions, 3 quadruple pattern sessions, and 3 quintuple pattern sessions.

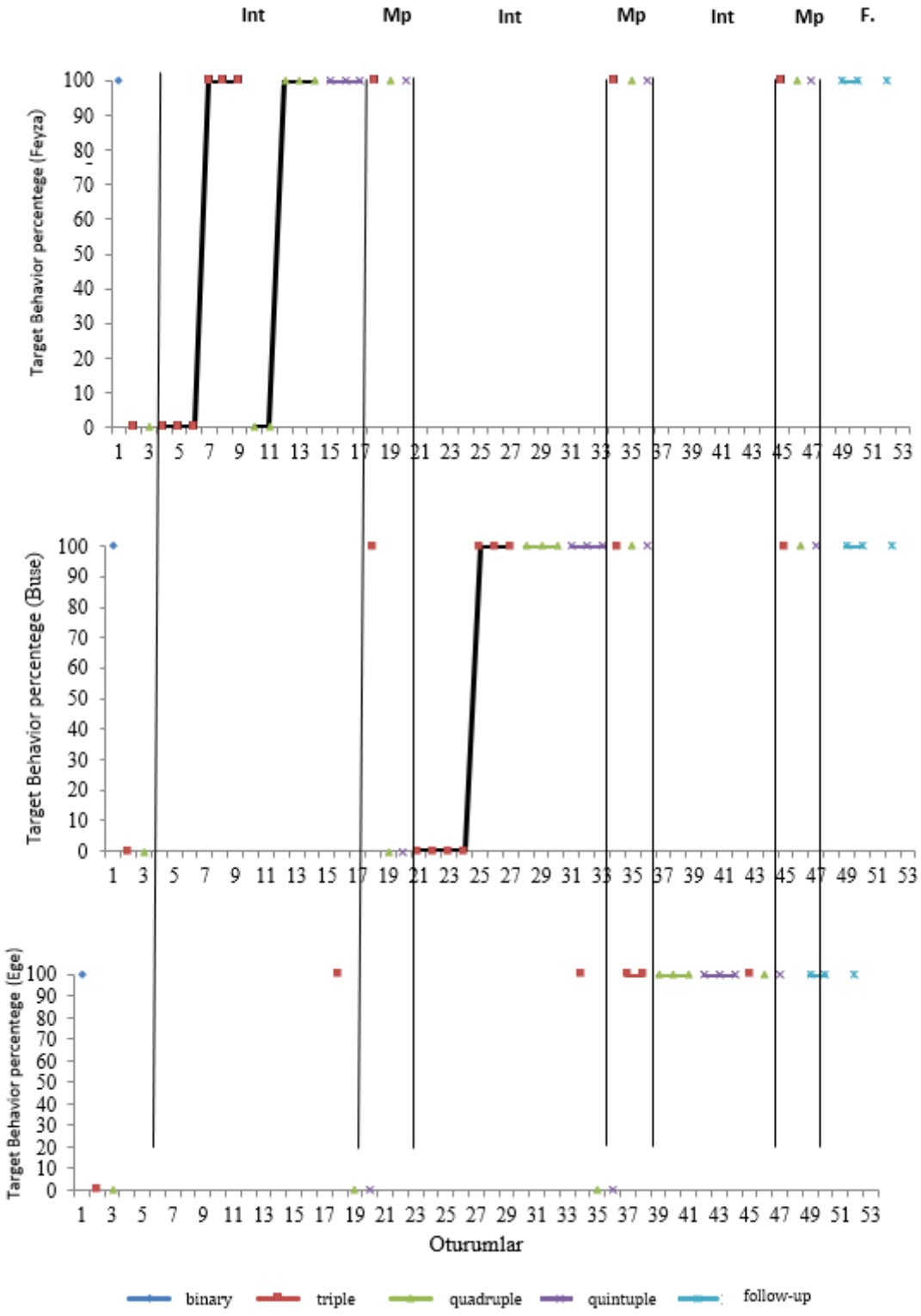

Figure 2. Initial level of pattern formation skills for Feyza, Buse, and Ege, skill percentages for practice and monitoring sessions

Generalization Session Findings

In the Generalization Sessions, it was observed that all three participants generalized their pattern formation skills with colored caps and pom-poms of intermediate colors to different settings. The Generalization Sessions were conducted before the teaching sessions and one week after the teaching sessions were completed.

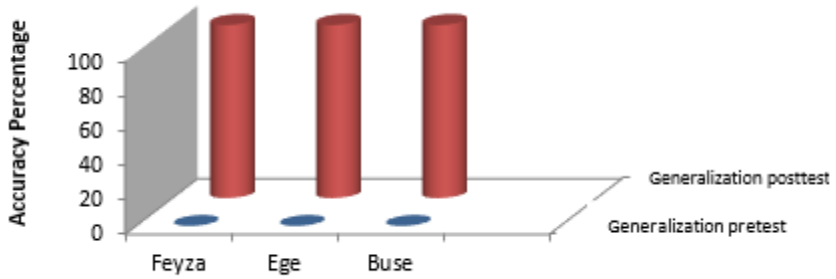

Figure 3. Feyza, Ege, and Buse's correct response percentages for pattern creation skill in different environments

Feyza, Ege, and Buse achieved a 100% level of pattern formation skill during the generalization sessions conducted in their homes and the rehabilitation centers they visited (Figure 3).

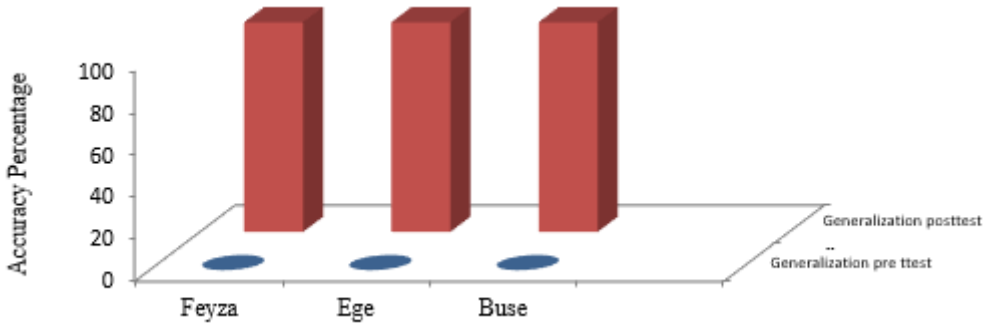

Figure 4. The accuracy percentages regarding Feyza, Ege, and Buse's ability to perform pattern formation with different objects

All participants were able to generalize their pattern formation skills at a 100% level during the generalization sessions conducted with pom-poms of intermediate colors and bottle caps. None of the three participants showed generalization skills regarding pattern formation in the pre-test generalization sessions. However, after the teaching sessions, participants demonstrated success in the generalization post-test sessions in a different environment with different materials (Figure 4).

Reliability Findings

The inter-rater reliability findings were obtained by reviewing 30% of the session video recordings by two preschool teachers. The inter-rater reliability findings are presented in Table 1.

Table 1. Inter-Rater Reliability Findings.

	Feyza	Ege	Buse
Baseline	%100	%100	%100
Intervention	%100	%100	%100
Daily probe	%100	%100	%100
Follow-up	%100	%100	%100

The intervention reliability data of the research were obtained by reviewing 30% of the sessions from the recordings by a guidance counselor who is pursuing a master's degree in special education. As seen in Table 2, a reliability coefficient of 100% was achieved in the obtained intervention reliability data.

Table 2. Intervention Reliability Findings.

	Feyza	Ege	Buse
Baseline	%100	%100	%100
Intervention	%100	%100	%100
Daily probe	%100	%100	%100
Follow-up	%100	%100	%100

According to the data obtained from the Social Validity forms for parents, parents mentioned that they had not heard of the concept of patterns before but observed that learning it was beneficial. One participant's mother (A1) expressed her thoughts as follows: “I am open to my child learning any new skill and knowledge. I really want him to learn something. When the kindergarten teacher directed us to the special education preschool, I was worried, thinking he had a more severe intellectual disability and couldn't learn anything. When I saw that he learned the concept of patterns, I was very happy.” Another participant's mother stated, “My child has started paying attention to the objects around him, noticing patterns in them, and showing an interest in pattern-related activities. He gets happy when he succeeds in doing them without difficulty.” The mother of another participant (A2) said, “My child tries to teach the things he has learned to his sibling. He has started collecting bottle caps and works on patterns with them, just like you taught him. He also works on patterns with buttons, colored beads, and clothespins.”

According to the data obtained from the Social Validity Form for teachers, teachers expressed that teaching the concept of patterns is necessary and will positively impact the instruction of other concepts. (Ö1) stated, “I find it very beneficial to support students with intellectual disabilities with different teaching methods; different stimuli will positively affect the children's perception.” (Ö2) expressed the opinion, “Different teaching methods facilitate the teaching of abstract concepts and ensuring active participation of students in class.” All three participants' preschool teachers indicated that teaching the concept of patterns is a priority goal.

Ege expressed his feelings by saying, “I am very happy to learn the concept of patterns, and working with pom-poms was great because I like the colors and the softness of the pom-poms.” Buse stated, “We can do this activity at home with clothespins, Legos, beads, small balls, and bottle caps. I'm already teaching it to my sibling; we're collecting bottle caps.” All three participants expressed that they were happy to learn the

concept of patterns. They also mentioned that they would like their kindergarten teachers to teach in a similar way and that they would like to engage in this activity with different objects in their free time.

CONCLUSION and DISCUSSION

The findings of the study concluded that FTIIM is an effective method for teaching pattern formation skills to preschool-age children with mild intellectual disabilities. Participants were able to retain the learned skill one, two, and four weeks after the instruction ended, and they demonstrated a 100% level of generalization to different objects and different environments. When looking at other studies where FTIIM was used and similar results were obtained, it was found that in a study conducted by Bozkurt (2001), FTIIM was effective in teaching kitchen skills such as making hot cereal, preparing sandwiches, and serving food to intellectually disabled children while teaching them food preparation and serving skills. In another study by Tongal (2010), the constant time-delay teaching method was used to teach fractions represented on picture cards to students with intellectual disabilities. It was observed that FTIIM was effective in teaching the skill of showing the mentioned fractions, and participants were able to generalize what they learned with a 100% success rate.

Aldemir (2011) investigated the effectiveness of FTIIM delivered through small group instructional arrangements in teaching academic skills to children with developmental disabilities during the preschool period. The study concluded that FTIIM delivered through small group instructional arrangements was an effective teaching method for children showing developmental disabilities in terms of teaching academic skills. Yüksel (2012) conducted research that found FTIIM to be effective in teaching children with intellectual disabilities the skill of recognizing coins. In a study by Badır (2014), it was observed that the dot placement technique delivered using FTIIM was effective in teaching individuals with intellectual disabilities the subtraction operation.

In Doğan's study (2016), it was observed that FTIIM delivered in small groups was effective in teaching children with autism spectrum disorder about various professions. Kaya (2016) used FTIIM to teach the concept of living-nonliving things to elementary school students with mild intellectual disabilities as part of a science lesson. The study concluded that FTIIM was an effective method for teaching the concept of living and nonliving things. Arı (2021) demonstrated the effectiveness of FTIIM in teaching reading and writing with a sound-based sentence approach to students with special needs

Akar Gökçe (2022) found that online fixed time-delay teaching was effective in introducing their own bodies to students with developmental disabilities. In Torun-Yeterge's study (2015), FTIIM was found to be effective in teaching intellectually disabled students to communicate their self-care needs using picture cards. Kurşun (2020) demonstrated the effectiveness of FTIIM in teaching students with intellectual disabilities how to tell time. There are also research studies conducted abroad that investigate the effectiveness of FTIIM.

Dogoe, Banda, Lock, and Feinstein (2011) concluded that FTIIM was an effective method in teaching two students with visual impairments to read product labels. Hooper, Ivy, and Hatton (2014) worked with four students with

visual impairments, teaching them to recognize and learn words using the Braille alphabet. They found that the method used, which included FTIIM, was 100% effective. Rogers, Hemmeter, and Wolery (2010) used FTIIM to teach swimming skills to children with other special needs and found it to be 52.7% effective.

Kurt and Parsons (2009) used FTIIM to teach classroom learning enhancement skills to children diagnosed with ASD (Autism Spectrum Disorder) and found it to be 72.5% effective. The results of this research, which obtained similar results to these studies, concluded that FTIIM is an effective method for teaching pattern formation skills to preschool-age children with mild intellectual disabilities. Chazin and Ledford (2020) conducted a study comparing the effectiveness of FTIIM and the method of gradually reducing prompts in teaching 10 preschool-age children to accurately label 32 targets. They found that FTIIM was more effective for five children, while the gradual prompt reduction method was effective for three children. The results for two children were inconclusive. In another study, Aldosiry (2020) compared the effectiveness of FTIIM and simultaneous prompting in teaching word reading skills to four students with intellectual disabilities aged 7 to 9. The study concluded that both FTIIM and simultaneous prompting were effective in improving reading skills in students with intellectual disabilities.

When looking at other research in the field where FTIIM has been used for teaching mathematical skills to individuals with special needs, several findings have emerged: In the study conducted by Kırcaali-İftar, Ergenekon, and Uysal (2008), it was observed that participants acquired and maintained skill steps related to addition and subtraction when taught using FTIIM. Flores (2004) found that FTIIM was effective in teaching multiplication skills to students with learning difficulties. The studies by Williams and Collins (1994) demonstrated the effectiveness of FTIIM when delivered with material cues. It was noted that when students were allowed to choose the material cues, instruction became more efficient. Additionally, all participants in these studies were able to generalize their skills, and the retention of learned skills was reported to be between 90% and 100% for three out of four students. The findings obtained in this research align with the acquisition, retention, and generalization results reported in other studies in the literature where FTIIM was used for teaching mathematical skills to individuals with special needs.

In literature FTIIM has been used for teaching single-step skills such as object identification skills, perceptual skills, teaching animal names, imitation skills, and teaching descriptive labels, several findings have emerged. These findings are consistent with the results obtained in this research. For example, research studies by Hawkins (2008), Soluaga, Leaf, Taubman, McEachin, and Leaf (2008), Tekin (1999), Valk (2003), and Yıldırım and Tekin-İftar (2002) have utilized SBSÖY for teaching various single-step skills. The results of these studies align with the findings of the current research. Furthermore, the results of this study are also consistent with other research in the literature where FTIIM has been used for teaching chain-like skills in daily living, basic swimming skills, kitchen skills, leisure skills, sign language instruction, academic skills, problem-solving, and word reading (Bozkurt, 2001; Easterling, 2004; Esirgemez-Aykut, 2007; Kurt, 2006; Rhodes, 1998; Riesen, McDonnell, Johnson, Polychronis, and Jameson, 2003; Rogers, Hemmeter, and Wolery, 2010; Saygın, 2009; Tucker-Cohen, Wolff-Heller, Alberto,

and Fredrick, 2008). These consistent results support the effectiveness of FTIIM across various skill domains and applications.

SUGGESTIONS

- This research, consistent with numerous studies that have employed SBSÖY, has demonstrated the effectiveness of FTIIM in teaching the concept of patterns to preschool children with mild intellectual disabilities.
- It can be recommended for practitioners to consider using FTIIM for teaching concepts in the preschool period.
- Pre-primary education teachers should receive comprehensive training in teaching methods related to special education during their undergraduate education.
- The Ministry of National Education should review the undergraduate courses for pre-primary education teacher programs..
- Despite the presence of an adaptation phase in the daily educational routine in preschool settings, adaptation for inclusive students is either not being done or is not being done adequately. During the times when students engage in play at learning centers, preschool education teachers have the most suitable hours to work one-on-one with inclusive students.
- In special education preschools under the Ministry of National Education, both preschool teachers and special education teachers are providing education to four students in the same classroom. Preschool education teachers are selected for these positions after undergoing a training course. It has been observed in an in-service program that the training provided to these teachers, including the researcher, did not include instructional methods.
- Many concepts can be taught to preschool children with moderate and mild intellectual disabilities, especially in inclusive education, using the FTIIM method. The FTIIM method can be applied in different classrooms and for different types of disabilities.
- The effectiveness and efficiency of the FTIIM method in teaching the concept of patterns can be compared with other teaching methods. Generalization sessions can involve parents, another teacher, or siblings. FTIIM can be utilized for teaching mathematical skills.
- These suggestions can serve as valuable directions for future research and implementation of the FTIIM method in the context of special education.

ETHICAL TEXT

In this article, the journal writing rules, publication principles, research and publication ethics, and journal ethical rules were followed. The responsibility belongs to the author (s) for any violations that may arise regarding the article. The study has been granted ethical approval by the Tokat Gaziosmanpaşa University Social and Human Sciences Research Ethics Board on February 22, 2023, with session number 05 and decision number 03.

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