European Journal of Special Education Research
ISSN: 2501 - 2428
ISSN-L: 2501 - 2428
Available on-line at: www.oapub.org/edu

DOI: 10.46827/ejse.v6i4.3515 Volume 6 | Issue 4 | 2020

DETERMINING THE REINFORCEMENT PRACTICES OF SPECIAL EDUCATION TEACHERS IN MATHEMATICS TEACHING[i]

Nihal Sen[ii],
Ahmet Yıkmış
Bolu Abant Izzet Baysal University,
Turkey

Abstract:
The purpose of this study was to determine the reinforcement practices of special education teachers in mathematics teaching. Phenomenology (phenomenology) design, one of the qualitative research methods, was used in the study. The study group consists of 10 special education teachers. In the study, purposeful sampling method was used to determine the study group, while the semi-structured interview technique was used to collect the data in the study. The obtained data were analyzed using content analysis technique. According to the results of the study, it was observed that teachers preferred secondary reinforcers more than primary reinforcers; it was also observed that the continuous reinforcement schedule was mostly used. Teachers mostly used interview and observation methods and the empirical assessment methods were less frequently used to determine effective reinforcers. In order to increase the effectiveness of reinforcement practices in mathematics teaching, teachers emphasized that reinforcers should be appropriate for the age, interests and wishes of students and reinforcement practices should be evaluated at regular intervals.

Keywords: special education, mathematics teaching, reinforcement

1. Introduction

A student with special needs is an individual who differs significantly from their peers in terms of individual and developmental characteristics and educational competencies due to various reasons (MoNE, 2012). Students with special needs need to learn functional academic skills required in social life in order to live independently in society and to be productive individuals. Functional academic skills include cognitive skills and abilities. Cognitive skills consist of skills such as reading-writing, mathematics, and life

[i] This study was presented as a proceeding at the VIth International Eurasian Educational Research Congress, 22 June 2019, Ankara, Turkey.
[ii] Correspondence: email nihalllsennn@gmail.com

science. Functional academic skills are skills that are related to the use of cognitive skills in daily life. For example, skills such as using money, using watches, calculating skills, and shopping are among functional academic skills (Erbaş, 2003).

Mathematics, which is one of the functional academic skills that should be acquired by students with special needs, is one of the primary skills that form the basis of these skills and are required by students to continue their school achievements and carry out basic activities in daily life. It is easier for students with special needs to gain independent living skills, to continue their lives and to integrate with the society, in parallel with their learning mathematics, as is the case with students with normal development.

Students with special needs are taught mathematics lessons from the first to the last year of the schools they attend, just like their peers with normal development (Sarı, 2003). The common purpose of mathematics education given to students with special needs is to enable them to gain the competence required to solve possible challenges they may encounter in daily life (Kameenui, 1990; Yıkmış, 2007). In line with this purpose, mathematics teaching, which is prepared according to the characteristics of students with normal development, should take into consideration students with special needs and it should be presented individually in line with the learning needs of the students (Hudson & Miller, 2006). In teaching the basic skills and concepts of mathematics to students with special needs, especially arranged learning-teaching strategies, methods and techniques, teaching environments, and tools should be included (Gürsel & Yıkmış, 1999). In addition, prompts, correction, feedback and reinforcement practices should be determined.

Reinforcement practices in mathematics teaching are one of the most important elements used in the acquisition of target behaviors. Reinforcement is the situation that occurs after a behavior which increases the likelihood of the behavior in the future. Reinforcement is divided into two; positive and negative reinforcement. Positive reinforcement is the giving of stimulants that increase the frequency of performing the desired behavior when placed in the environment and reduce the frequency of undesirable behavior when removed from the environment. Negative reinforcement is the removal of stimulant that the organism does not like from the environment in order to increase the frequency of the desired behavior (Cooper, Heron, & Heward, 2014).

Stimulants that increase the probability of repeating a behavior in the future can be defined as reinforcers. Reinforcers are divided into two; primary and secondary reinforcers. Biological stimuli that are not based on learning but affect an individual's behavior are called primary reinforcers. Primary reinforcers are often vital stimuli. Stimuli that do not meet vital needs and have a positive effect on individuals constitute secondary reinforcers (Tekin-İftar, 2014).

Effective reinforcement practices that teachers will use in mathematics lessons contribute to the motivation of students towards the mathematics lesson, to participate in the lesson cognitively and to increase their level of success. In order to increase the effectiveness of teaching practices applied during teaching mathematics skills and

concepts, it should be used intensively during teaching. Based on this, it is important to determine effective reinforcement practices for each student in order for mathematics teaching to be successful (Cooper et al., 2014).

Several studies related to this research were found in literature including the effect of positive reinforcement, instructional strategies and negative reinforcement on problem behaviors and academic performance for students with special needs (Schieltz, Wacker, Suess, Graber, Lustig, & Detrick, 2019), teaching systematic reinforcer assessment method to teachers working in the field of special education (Turhan, Ünal, and Toper-Korkmaz, 2018), the use of reinforcers and perceptions of special education teachers (Dovey, Francis, Corbett, & Dibb, 2017), the effect of inclusion and positive reinforcement in the classroom for students with and without disability (Morin, 2016), evaluating the opinions of families about the use of reinforcer in providing daily life skills to children with mild mental retardation (Kızılkaya, 2016), and determination of reinforcement and punishment practices of inclusive class and special education class teachers for mentally retarded students (Çelik & Eratay, 2007). However, the absence of any research on reinforcement practices used by special education teachers in mathematics teaching has revealed the need for a research on this subject. Due to the limited number of studies on reinforcement practices used in teaching mathematics to students with special needs, it is believed that studies on this subject will contribute meaningfully to the field and shed light on special education practices.

The inadequacy of teachers in reinforcement practices causes the appropriate behaviors of students with special needs not to be reinforced on time. Reinforcement practices play an important role in enabling students with special needs to benefit effectively from learning opportunities in educational settings. Teachers' opinions and needs should be correctly identified in order to contribute to the development of the competencies of teachers to plan and apply skills teaching studies based on applied behavior analysis in the teaching process from determining the student's educational needs to evaluation. This study will make remarkable contributions to determining the reinforcement practices used by special education teachers in mathematics teaching, defining, presenting the missing aspects and developing solutions to existing problems, and will guide further research. As a result, this research aims to determine the reinforcement practices used by special education teachers in mathematics teaching. To achieve this, answers to the following questions were sought:

1) What are the opinions of teachers about the concept of reinforcement in general?
2) What are the types of reinforcers teachers use in mathematics teaching?
3) What are the methods of determining effective reinforcers for students with special needs in teaching mathematics by teachers?
4) What are the reinforcement schedules used by teachers in mathematics teaching?
5) What are the positive and negative aspects of reinforcement practices that teachers use in mathematics teaching?
6) What are the problems of teachers about reinforcement practices in mathematics teaching and their suggestions for solving the problems?

7) What are the teachers' suggestions for increasing the effectiveness of reinforcement practices in mathematics teaching?

2. Method

2.1 Research Design

Phenomenology (phenomenology) design, one of the qualitative research methods, was used in this study to determine the reinforcement practices used by special education teachers in mathematics teaching. Phenomenological researches are one of the qualitative research models that aim to reveal the facts and experiences of individuals from their own perspectives and perceptions (Lester, 1999). It also reveals the perceptions and life experiences of different individuals regarding a concept or phenomenon. In such studies, it is essential to reveal the different and common points of various phenomena experienced by different people from the perspective of individuals (Creswell, 2007; Mills & Gay, 2019; Patton, 2014; Saban & Ersoy, 2016).

2.2 Study Group

The study group of this research consists of 10 special education teachers. In the study criterion sampling, which is one of the purposeful sampling methods, it was used when determining the study group. The researcher who plans to study in purposeful sampling uses his own judgment about who to choose and selects the most suitable participants to work in line with his purpose (Balcı, 2018). The criterion sampling method was used in this study, and it is the study of all situations that meet a predetermined set of criteria using a sampling method (Şen & Yıldırım, 2019; Yıldırım & Şimşek, 2018). Information on the age, gender, and professional experiences of the participants are presented in Table 1.

Table 1: Demographic Characteristics of the Participants

Demographic Feature	**Variable**	*f*	**%**
Gender	Female	7	70
	Male	3	30
Age	21-25	4	40
	26-30	3	30
	31-35	2	20
	36-40	1	10
Teaching Seniority	1-5	6	60
	6-10	3	30
	11-15	1	10

As shown in Table 1, 70% of the teachers participating in the study are female ($f = 7$) and 30% ($f = 3$) are male. Looking at the age groups, 40% ($f = 4$) constitutes 21-25 age group teachers, 30% ($f = 3$) constitutes the 26-30 age group, 20% ($f = 2$) constitutes the 31-35 age group, while the 36 -40 age group constitutes 10% ($f = 1$). Considering the seniority years of the teachers who constitute the study group, it was determined that 60% ($f = 6$) of the

teachers teaching experience was between 1-5 years, 30% of the teachers fell between the years 6-10 (f = 3) and the teachers with 11-15 years of experience constitute 10% (f = 1) of the teachers in the study group.

2.3 Data Collection

This study was conducted to determine the reinforcement practices used by special education teachers in mathematics teaching. The data were collected using the semi-structured interview technique. During the research process, interviews were conducted by the teachers using the interview forms prepared by the researchers. The interview form consists of two parts. The first part includes personal information about special education teachers, and the second part includes interview questions.

2.4 Analysis

Content analysis was used to analyze the data obtained from the research. Content analysis basically requires clustering the findings obtained from the collected data under certain common headings and interpreting them in the light of the information obtained (Yıldırım & Şimşek, 2018). For the content analysis to be carried out in accordance with the research problem, revealing the unclear themes and the dimensions of the themes was determined as the main goal. The researcher examined the literature and then applied the basic processes of content analysis using the steps appropriate to the nature of his research questions and data.

The relevant explanations (P1: Participant 1, P2: Participant 2) were given by giving a code number to the teachers whose opinions were consulted in the course of the analyses. The data obtained through the interview technique were digitized and expressed as frequency and percentage.

2.5 Validity and Reliability

In order to ensure validity of the study, a conceptual framework was created, general explanations were made, and then the findings were presented in detail. During the interviews, when necessary, new questions were added to the interview questions or extra explanations were made about the question (Yıldırım & Şimşek, 2018). Necessary explanations have been made so that the findings can be tested in other studies. In the presentation of the research results, direct quotations were included without giving the identities of the participants. Quotations are presented with a code number assigned for each teacher (P1, P7, P9 etc.) at the beginning of the statement.

In order to ensure the reliability of the study, the code and theme list that emerged after the research and coded by two researchers separately was finalized. After the code and theme list was finalized, the data were evaluated by two researchers according to the code and theme list. Items with "Agreement" and "Disagreement" were determined. For the reliability of the study, the formula stated by Miles and Huberman (1994) was used as P (Percentage of Agreement %) = (Number of agreements)/ [(Number of agreements)

+ (Number of disagreements)] × 100, and as a result of the calculation, P = 95% value. Thus, a high level of consistency was found between two coders.

3. Results

Within the scope of the research, a total of seven questions were asked the participants, and the findings of the data obtained from these questions are given below for each question. As a result of the examination of teachers' opinions, the findings divided into themes and sub-themes were presented in the form of tables and direct quotations were made from the opinions of the teachers who participated in the study.

3.1 Teachers' Views on the Concept of Reinforcement

Teachers answered the question about the concept of reinforcement as a stimulus that increases positive/desired behavior and a practice that encourages/motivates learning. Teachers' opinions about the concept of reinforcement are presented in Table 2.

Table 2: Teachers' Opinions about the Concept of Reinforcement

Teacher Opinions	*f*	%
Presenting stimulus that increase positive/desirable behavior	8	80
Practice that encourages/motivates learning	2	20

Teachers who define reinforcement as presenting stimulus that increase positive/desired behavior; they stated with the words "*… Presenting the stimulus that we use as an object, food-drink or activity that enables the emergence of the desired behavior…"* (P3), *"… Reinforcement is presenting the stimulus that increase the occurrence of the behavior and sustaining the behavior that the organism enjoys…"* (P10). Teachers who define reinforcement as a practice that encourages/motivates learning, *"... Any practice that encourages the child to learn, encourages the child to learn ...*" (P4), "*... It is a kind of support that motivates the student to learn or increases his willingness ..."* (P7) expressed it in words.

3.2 Teachers' Views Regarding the Types of Reinforcers Used in Mathematics Teaching

When asked about the types of reinforcers they use in mathematics teaching, teachers used food and beverage reinforcers and sensory reinforcers as the primary reinforcers; They stated that among the secondary reinforcers, they used social reinforcers, object reinforcers, activity reinforcers, symbol reinforcers and privilege reinforcers. Teachers' opinions on the types of reinforcers are shown in Table 3. As seen in Table 3, most of the primary reinforcers were food and beverage reinforcers (*f* = 8), while secondary reinforcers mostly used social reinforcers (*f* = 7) and at least privilege reinforcers (*f* = 1).

Table 3: Teachers' Opinions about the Types of Reinforcers Used in Mathematics Teaching

Teacher Opinions	*f*	%
Primary Reinforcers		
Food and beverage reinforcers	8	25.80
Sensory reinforcers	2	6.45
Secondary Reinforcers		
Social reinforcers	7	22.58
Object reinforcers	5	16.12
Activity reinforcers	4	12.90
Symbol reinforcers	4	12.90
Privilege reinforcers	1	3.22

When asked about the types of reinforcers they use in mathematics teaching, the teachers said: "*… It can be ice cream in the summer or chips…"* (P1), *"… I give the toys they like, I also do their favorite activities…"* (P2), *"… Actually, this depends on my students, but in general. To say that I use food reinforcer, I use toy reinforcer, I use verbal reinforcer… "*(P6), "*… I use symbol reinforcer and I include social reinforcers with it. Sometimes, we also use object reinforcers, such as rewarding with stationery ..."* (P10).

3.3 Teachers' Opinions Regarding Methods of Determining Effective Reinforcers in Mathematics Teaching

Teachers use interview (meeting with the student himself, meeting with people in the student's life, offering options before the skill), observation (natural and structured environment), empirical evaluation (single stimulus, double stimulus and multiple stimulus presentation) methods in mathematics teaching in order to determine effective reinforcers for students with special needs. Teachers' opinions on the methods of determining effective reinforcers for students with special needs in mathematics teaching are presented in Table 4. As shown in Table 4, among the methods based on interview, the answer was mostly "interviewing people in the life of the student" ($f = 10$). Among the observation responses, it is seen that the most "observation in the natural environment" ($f = 10$) answer is given, and the same number of answers were given in the empirical evaluations ($f = 1$).

Table 4: Teachers' Opinions Regarding Methods of Determining Effective Reinforcers in Mathematics Teaching

Teacher Opinions	*f*	%
Interview		
Interviewing people in the student's life	10	28.57
Meeting with the student himself	4	11.42
Offer choice before skill	3	8.57
Observation		
Observation in the natural environment	10	28.57
Observation in the structured environment	5	14.28
Trial-Based Evaluation		
Single stimulus presentation	1	2.85
Double stimulus presentation	1	2.85
Multiple stimulus presentation	1	2.85

Teachers opinion about the methods of determining effective reinforcers for students with special needs "*… I observe, meet with their families, ask children…*" (P8), "*… I meet with their family. I observe the student during the breaks and class hours. I request for the student's own preference. I offer a chance to choose… "*(P10) expressed their words.

3.4 Teachers' Views Regarding Reinforcement Schedules They Use in Mathematics Teaching

Considering the results of the research, teachers mostly used the continuous reinforcement schedule (*f* = 9). In the second and third place, their preferred reinforcement rate is the fixed ratio reinforcement rate (*f* = 6) and the variable time interval reinforcement rate (*f* = 3), respectively. Among the consolidation schedules used, the least used one is the variable ratio (*f* = 2) and the fixed time interval (*f* = 2). As a result of the research, it is seen that some teachers never use reinforcement schedules in mathematics teaching (*f* = 2). Teachers' opinions about the reinforcement schedules they use in mathematics teaching are presented in Table 5.

Table 5: Teachers' Views Regarding the Reinforcement Schedules They Use in Mathematics Teaching

Teacher Opinions	*f*	%
Continuous reinforcement schedule	9	37.5
Intermittent reinforcement schedule		
Fixed ratio reinforcement schedule	6	25
Variable time interval reinforcement schedule	3	12.5
Variable ratio reinforcement schedule	2	8.33
Fixed time interval reinforcement schedule	2	8.33
Those who do not use a reinforcement schedule	2	8.33

When asked about the reinforcement schedules they use in mathematics teaching, one of the teachers stated that "*… A subject that we just started teaching is at the behavior acquisition*

stage, I offer reinforcement after every correct behavior with the continuous reinforcement schedule…" (P5).

3.5 Teachers' Opinions Regarding the Positive Aspects of Reinforcement Practices Used in Mathematics Teaching

Teachers stated that reinforcement practices in mathematics teaching have positive aspects such as increasing student motivation, increasing the effectiveness of teaching, increasing attention span, gaining desired behavior, gaining a sense of self-confidence and facilitating classroom management. Teachers' opinions about the positive aspects of reinforcement practices in mathematics teaching are presented in Table 6. As shown in Table 6, it is seen that reinforcement practices increase motivation the most (f = 5), which at least give the feeling of self-confidence (f = 1) and facilitate classroom management (f = 1).

Table 6: Teachers' Opinions Regarding the Positive Aspects of Reinforcement Practices Used in Mathematics Teaching

Teacher Opinions	f	%
Increasing the motivation	5	31.25
Increasing the effectiveness of teaching	4	25
Increase attention span	3	18.75
To give desired behavior	2	12.5
To gain a sense of self-confidence	1	6.25
Making classroom management easier	1	6.25

Regarding the positive aspects of the reinforcement practices they use in mathematics teaching, teachers *"… motivates them to work…"* (P1), *"… It provides attention and thus the effectiveness of teaching increases…"* (P2), *"… It encourages learning, it increases the child's motivation…"* (P4), *"… I can see the behavior I want in children in a short time…"* (P9).

3.6 Teachers' Opinions Regarding the Negative Aspects of Reinforcement Practices Used in Mathematics Teaching

Teachers stated that the reinforcement practices they use in mathematics teaching have negative aspects such as being difficult to fade out, food and beverage reinforcers causing health problems, less time spent on teaching, students' satisfaction and difficulty in applying them during group education. Some of the teachers stated that it has no negative features. Teachers' opinions about the negative aspects of reinforcement practices in mathematics teaching are presented in Table 7. In Table 7, the negative feature of reinforcement practices is that it is the most difficult to fade (f = 7), the least is that students reach satisfaction (f = 1) and that it is difficult to apply in group education (f = 1).

Table 7: Teachers' Opinions Regarding the Negative Aspects of Reinforcement Practices They Use in Teaching Mathematics

Teacher Opinions	*f*	%
Difficult to fade	7	41.17
Food and beverage enhancers cause health problems	4	23.52
Decrease in teaching time	2	11.76
Students' satisfaction	1	5.88
Difficult to apply in group education	1	5.88
No downsides	2	11.76

One of the teachers, who stated that reinforcement practices used in mathematics teaching do not have negative features, stated the following "*… I do not think that reinforcement can have a negative feature when faded correctly…"* (P10).

3.7 Teachers' Opinions on Problems Regarding Reinforcement Practices in Mathematics Teaching

Teachers stated that they faced problems such as inability to apply reinforcement schedules in reinforcement practices for mathematics teaching, difficulty in applying reinforcement in group education, difficulty in determining reinforcers, difficulty in fading, students' satisfaction with reinforcement, students' access to reinforcement with their own means, and time management. One of the teachers stated that he had no problems. The opinions of the teachers about the problems related to reinforcement practices in mathematics teaching are presented in Table 8. In Table 8, it is seen that teachers mostly have problems with not being able to apply reinforcement schedules (f = 5), at least the students' reaching satisfaction (f = 1), students' reaching reinforcement by their own means (f = 1) and time management (f = 1).

Table 8: Teachers' Opinions on Problems Related to Reinforcement Practices in Mathematics Teaching

Teacher Opinions	*f*	%
Failure to apply reinforcement schedules	5	27.77
Practice difficulty in group education	3	16.66
Difficulty determining reinforcement	3	16.66
Difficult to fade	3	16.66
The satisfaction of the student	1	5.55
Students reach the reinforcement with their own means	1	5.55
Time management	1	5.55
No problem	1	5.55

One of the teachers regarding the problems they encountered in reinforcement practices in mathematics teaching stated: *"… It is really difficult to progress very systematically while making it faint… It is difficult to choose reinforcers and schedules suitable for the individual differences and needs of each student…"* (P3).

3.8 Opinions of Teachers Regarding Suggestions for Solving Problems Related to Reinforcement Practices in Mathematics Teaching

Teachers have stated that they change and transform the reinforcers they use to eliminate the problems they encounter in their reinforcement practices, use the group-based reinforcement system, use transition strategies, systematic and consistent, take reminder notes, cooperate with family and teachers, and evaluate reinforcement. Teachers' opinions on solution suggestions to eliminate the problems they encounter in mathematics teaching and reinforcement practices are presented in Table 9. Table 9 shows that teachers mostly changed and transform reinforcements ($f = 4$) to eliminate the problems they faced, and at least they were systematic and consistent ($f = 1$), they took reminder notes ($f = 1$), collaborated with parents and teachers. ($f = 1$) and they evaluated reinforces ($f = 1$).

Table 9: Teachers' Opinions Regarding Suggestions for Solving Problems Related to Reinforcement Practices in Mathematics Teaching

Teacher Opinions	**f**	**%**
Changing and transforming the reinforcers	4	25
Using methods of determining reinforcers	3	18.75
Using a group-based reinforcement system	3	18.75
Using transition strategies	2	12.5
To be systematic and consistent	1	6.25
Taking reminder notes	1	6.25
Collaborating with parents and teachers	1	6.25
Evaluating reinforcers	1	6.25

The opinions of teachers regarding solution suggestions in order to eliminate the problems they encounter in reinforcement practices in mathematics teaching *"… If we are working with a teacher; We act together on the reinforcers we use, reinforcement schedules and fading…"* (P3), *"… I think of developing alternative reinforcement types…"* (P10).

3.9 Teachers' Opinions Regarding Suggestions for Increasing the Effectiveness of Reinforcement Practices in Mathematics Teaching

The teachers stated that the reinforcers used in mathematics teaching should be appropriate to the age, interests and wishes of the student, reinforcers should be evaluated at regular intervals, systematic reinforcer practice should be applied, the reinforcers should be diversified, other reinforcers should be used alongside social reinforcers, the reinforcers would be silent over time and natural reinforcers would be used. The opinions of the teachers regarding the suggestions for increasing the effectiveness of reinforcement practices in mathematics teaching are presented in Table 10. When we look at Table 10, it is observed that most of the teachers' reinforcers are suitable for the age, interests and wishes of the student ($f = 8$); On the other hand, it is seen that they made suggestions for reinforcement evaluation at regular intervals ($f = 4$).

It is seen that teachers emphasized that the least reinforcers should be dimmed over time (f = 1) and natural reinforcers should be used (f = 1).

Table 10: Teachers' Opinions Regarding Suggestions for Increasing the Effectiveness of Reinforcement Practices in Mathematics Teaching

Teacher Opinions	f	%
Reinforcers are appropriate for the age, interests and wishes of the student	8	38.09
Evaluating reinforcers at regular intervals	4	19.04
Systematic reinforcer practice	3	14.28
Diversification of reinforcers	2	9.52
Using other reinforcers with social reinforcers	2	9.52
Reinforcers becoming faint over time	1	4.76
Using natural reinforcers	1	4.76

Regarding their suggestions for increasing the effectiveness of reinforcement practices in mathematics teaching, the teachers stated: *"… Various reinforcers should be used in the lesson…*" (P2), *"… Different materials and activities can be used according to the interests and wishes of the students…*" (P3).

4. Discussion

In this study, which was conducted to determine the reinforcement practices used by special education teachers in mathematics teaching, interviews were conducted with the relevant participants and the results of the research were reached by analyzing the data obtained from the interviews.

When the results of the research are examined, it is seen that the teachers defined the concept of reinforcement as providing stimulus that increase positive/desired behavior and a practice that encourages/motivates the lesson. These definitions are some of the features that define the concept of reinforcement. When this finding is examined in terms of the definitions regarding reinforcement (Cooper, Heron, & Heward, 2014; Peterson, Lerman, & Nissen, 2016), it shows that special education teachers define the concept of reinforcement in several aspects.

Findings of this study showed that special education teachers use secondary reinforcers more than primary reinforcers in mathematics teaching. It was observed that teachers mostly used food and beverage reinforcers for primary reinforcers, while secondary reinforcers mostly used social reinforcers, and least privilege reinforcers. Secondary reinforcers are preferred more in educational environments due to their benefits such as being usable without disrupting the usual flow during daily activities, being easy to apply, facilitating saturation control compared to primary reinforcers and being more effective than primary reinforcers in generalization (Cooper et al., 2014; Alberto & Troutman, 2016)

Teachers mostly use interview and observation methods, and least empirical assessment methods, in order to determine effective reinforcers for students in

mathematics teaching. It is believed that the reason teachers mostly use interview and observation methods is that these methods are easy to apply and do not require much time and resources (Hagopian, Long, & Rush, 2004).

Finding of this study showed that teachers mostly used the continuous reinforcement schedule. Teachers prefer to use the continuous reinforcement schedule because it is effective both in gaining a new behavior and increasing the frequency of the infrequent behavior. The second and third preferred reinforcement schedule is the fixed ratio reinforcement schedule and the variable time interval reinforcement ratio, respectively.

Among the reinforcement schedules used, the least used ones are the variable ratio and fixed time interval reinforcement schedules. Cooper et al. (2014) stated that it is difficult to use the variable ratio reinforcement schedule systematically in practice environments, it is stated that reinforcers can be presented randomly in the practice environment, the rate of reinforcement cannot be met or may sometimes be overlooked. As a result of the research, it is seen that some teachers never use reinforcement schedules in mathematics teaching. In training situations, reinforcers should be used in accordance with the reinforcement schedules. Reinforcement schedules are important in terms of their effect on the frequency, range and resistance to change dimensions of the behavior.

Teachers stated that reinforcement practices in mathematics teaching mostly increased students' motivation, at least they gave students a sense of self-confidence and facilitated classroom management. Özyürek (2010) stated that the use of effective reinforcers not only enables students to participate in their learning life, to be successful in lessons, and to reduce their negative behaviors, but it also affects positively the students' attitudes towards school, lessons, teachers, and students themselves.

As the negative feature of reinforcement practices in mathematics teaching, it is the most difficult to fade out, the least is that students reach satisfaction and the practice in group education is difficult. Alberto and Troutman (2016) drew attention to the problem of rate forcing in the process of thinning reinforcement. When thinning is done too quickly, the correct response rate determined to reach reinforcement is too high, so the student will not be reinforced enough to ensure the permanence of the learned behavior. In this case, he may begin to show less or not show the targeted behavior.

It is observed that teachers mostly have problems not applying the reinforcement schedules, at least the student's satisfaction, the student's access to reinforcer with their own means and time management. If teachers cannot apply reinforcement schedules correctly, students' learning performances and their trust in teachers may be adversely affected (Alberto & Troutman, 2016).

Teachers mostly change and transform reinforcers to eliminate the problems they face; at least, it is observed that they are systematic and consistent, they take reminder notes, cooperate with family and teachers, and make reinforcer evaluation. Reinforcers that are effective for each student should be diversified in the reinforcement process. Since there is no alternative to the reinforcers used, it may cause saturation in students, so reinforcers may lose their effect. While the effectiveness of a highly preferred but

continuously used reinforcer decreases, the effectiveness of less preferred but diversified reinforcers may increase (Bowman, Piazza, Fisher, Hagopian, & Kogan, 1997; Cooper et al., 2014). In parallel with this finding of the study, similar findings are seen in the relevant literature (Lailli et al., 1999; Piazza et al., 1997; Solberg, Hanley, Layer, & Ingvarsson, 2007).

Teachers believe that the most reinforcers in mathematics teaching are appropriate to the age, interests and wishes of the student. On the other hand, they made suggestions to evaluate reinforcers at regular intervals. Teachers' suggestions for reinforcement practices in mathematics teaching also overlap with the literature (Hanley, Iwata, & Roscoe, 2006; Holburn, Nguyen & Vietze, 2004).

In line with the results of this research:

- Relevant special education courses can be added for teacher candidates studying at education faculties of universities.
- Every academic year, in-service training should be given to teachers on special education practices.
- Teachers working with students with special needs can be researched and supported by observations to determine the reinforcers they use for students.
- Experimental studies and operational research can be conducted for the education of students with special needs in general education settings.

About the Authors

Nihal Sen (corresponding author) is a PhD candidate in the department of Special Education at Bolu Abant Izzet Baysal University, Turkey. Her research interests include single-subject design in special education, meta-analysis of single-subject research, teaching mathematics to individuals with special needs, learning disability.

Ahmet Yıkmış is an associate professor at Bolu Abant Izzet Baysal University in the department of special education. His research interests are single-subject design in special education, teaching mathematics to individuals with special needs, use of technology in special education, learning disability and applied behavioural analysis.

References

Alberto, P. A., & Troutman, A. C. (2016). *Applied behavior analysis for teachers* (Interactive 9th Edition). New Jersey, NJ: Pearson.

Balcı, A. (2018). *Sosyal bilimlerde araştırma yöntem, teknik ve ilkeler*. Ankara: Pegem Akademi.

Bowman, L. G., Piazza, C. C., Fisher, W. W., Hagopian, L. P., & Kogan, J. S. (1997). Assessment of preference for varied versus constant reinforcers. *Journal of Applied Behavior Analysis*, *30*(3), 451-458.

Çelik, İ., & Eratay, E. (2007). Kaynaştırma sınıfı ve özel eğitim sınıfı öğretmenlerinin sınıflardaki zihin engelli öğrencilere yönelik pekiştireç ve ceza uygulamalarının belirlenmesi. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi*. 7(1), 47-63.

Cooper, J. O., Heron, T. E. & Heward, W. L. (2014). *Applied behavior analysis*. (2nd Edition). Harlow, Essex: Pearson Education Limited.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches* (2nd Edition). USA: SAGE Publications.

Dovey, T. M., Francis, R., Corbett, S. ve Dibb, B. (2017). Perception and use of reinforcement by special education teachers. *Journal of Research in Special Educational Needs*, *17*(4), 282-293.

Erbas, D. (2003). Varolan performans düzeyinin belirlenmesi ve yazılması. O. Gürsel (Ed.), *Bireyselleştirilmiş Eğitim Programlarının Geliştirilmesi* (69-80). Eskişehir, Anadolu Üniversitesi Yayınları.

Gürsel, O. ve Yıkmış, A. (1999). Engelli çocuklara matematik becerilerinin kazandırılmasında öğretmen ve öğrenci etkileşiminin basamaklandırılması. *Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 2*(3), 164- 175.

Hagopian, L. P., Long, E. S., & Rush, K. S. (2004). Preference assessment procedures for individuals with developmental disabilities. *Behavior Modification*, *28*(5), 668-677.

Hanley, G., Iwata, B., & Roscoe, E. (2006). Some determinants of change in preference over time. *Journal of Applied Behavior Analysis, 39*, 189-202.

Holburn, S., Nguyen, D., & Vietze, P. M. (2004). Computer-assisted learning for adults with profound multiple disabilities. *Behavioral Interventions, 19*(1), 25-37.

Hudson, P. ve Miller, S. P. (2006). *Designing and implementing mathematics instruction for students with diverse learning needs*. Boston: Allyn and Bacon.

Kızılkaya, A. E. (2016). *Hafif düzeyde zihin engelli çocuklara günlük yaşam becerilerinin kazandırılmasında ailelerin pekiştireç kullanımı ile ilgili görüşlerinin değerlendirilmesi* (Yayımlanmamış yüksek lisans tezi). Necmettin Erbakan Üniversitesi, Eğitim Bilimleri Enstitüsü, Özel Eğitim Bölümü, Konya.

Lalli, J. S., Vollmer, T. R., Progar, P. R., Wright, C., Borrero, J., Daniel, D., ... & May, W. (1999). Competition between positive and negative reinforcement in the treatment of escape behavior. *Journal of Applied Behavior Analysis*, *32*(3), 285-296.

Lester, S. (1999). *An introduction to phenomenology research*. UK: Taunton.

Miles, M. B. ve Huberman, A. M. (1994). *Qualitative Data Analysis: An Expanded Sourcebook*, (second edition), Newbury Park, CA: Sage.

Mills, G. E., & Gay, L. R. (2019). *Educational research: Competencies for analysis and applications*. New Jersey: Pearson Publication.

MoNE (Ministry of National Education). 2012. Ozel Egitim Hizmetleri Yonetmeligi. https://orgm.meb.gov.tr/meb_iys_dosyalar/2012_10/10111226_ozel_egitim_hizmetleri_yonetmeligi_son.pdf

Morin, D. (2016). The Effects of Inclusion and Positive Reinforcement Within the Classroom. Honors Program Contracts. 4. http://scholarworks.merrimack.edu/honors_component/4

Özyürek, M. (2010). *Olumlu sınıf yönetimi*. Ankara: Kök Yayıncılık.

Patton, M. Q. (2014). *Nitel araştırma ve değerlendirme yöntemleri*. Ankara: Pegem Akademi.

Peterson, C., Lerman, D. C., & Nissen, M. A. (2016). Reinforcer choice as an antecedent versus consequence. *Journal of Applied Behavior Analysis*, *49*(2), 286-293.

Piazza, C. C., Fisher, W. W., Hanley, G. P., Remick, M. L., Contrucci, S. A., & Aitken, T. L. (1997). The use of positive and negative reinforcement in the treatment of escape maintained destructive behavior. *Journal of Applied Behavior Analysis*, *30*(2), 279-298.

Saban, A. ve Ersoy, A. (2016). *Eğitimde nitel araştırma desenleri*. Ankara: Anı Yayınları.

Sarı, H. (2003). *Özel eğitime muhtaç çocukların eğitimleriyle ilgili çağdaş öneriler*. (2. Baskı), Ankara: Pegem Yayınları.

Schieltz, K. M., Wacker, D. P., Suess, A. N., Graber, J. E., Lustig, N. H., & Detrick, J. (2019). Evaluating the Effects of Positive Reinforcement, Instructional Strategies, and Negative Reinforcement on Problem Behavior and Academic Performance: an Experimental Analysis. *Journal of Developmental and Physical Disabilities*, 1-25.

Solberg, K. M., Hanley, G. P., Layer, S. A., & Ingvarsson, E. T. (2007). The Effects of Reinforcer Pairing and Fading on Preschoolers' Snack Selections. *Journal of Applied Behavior Analysis*, *40*(4), 633-644.

Şen, S. & Yıldırım, İ. (2019). *Eğitimde araştırma yöntemleri.* Ankara: Nobel Yayınevi.

Tekin-İftar, E. (2014). *Uygulamalı davranış analizi*. Ankara: Vize Yayıncılık.

Turhan, C., Ünal, F., & Toper-Korkmaz, Ö. Özel Eğitim Alanında Çalışan Öğretmenlere Sistematik Pekiştireç Değerlendirme Yönteminin Öğretimi. *İstanbul Aydın Üniversitesi Eğitim Fakültesi Dergisi*, *4*(1), 79-106.

Yıkmış, A. (2007). *Etkileşime dayalı matematik öğretimi* (2. Baskı). Ankara: Kök Yayıncılık.

Yıldırım, A. ve Şimşek, H. (2018). *Sosyal bilimlerde nitel araştırma yöntemleri*. Ankara. Seçkin Yayıncılık.