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Pre-service teachers' Knowledge and Opinions about Students at Risk for Dyscalculia[1]

Gülnisa Demirel[2], Gülsüm Ateş [3], Ebru Korkmaz[4]

(Research Article)

Abstract

The purpose of this study is to examine the opinions and knowledge of primary school mathematics pre-service teachers about students with learning disabilities in mathematics. The data collection tool of this study, which was conducted by adopting the case study method from qualitative research methods, is 8 semi-structured questions prepared by the researchers and an expert mathematics educator in the field. In this study, which was carried out within the scope of the 2209/A University students research projects support program, a collective seminar was given to a total of 66 volunteer primary school mathematics pre-service teachers about dyscalculia risk groups. After the basic awareness of the pre-service teachers about dyscalculia risk groups was established, their current information and opinions were obtained with the semi-structured opinion form prepared with the help of Google Forms. The obtained data were examined with the help of content analysis. In the light of the findings, it was seen that almost all of the pre-service teachers knew about mathematics learning disabilities and their results. In addition, it was seen that the pre-service teachers who were informed about the basic causes of mathematics learning disabilities had sufficient knowledge about the methods and techniques they should apply when they encountered this problem. On the other hand, almost half of the participants did not see themselves as sufficient due to their lack of current experience. In line with the findings of the study, it is recommended that especially primary school mathematics pre-service teachers and classroom teachers should be informed more about the subject and that joint projects should be carried out with the help of institutions and organizations where pre-service teachers can gain experience.

Keywords: Dyscalculia risk groups, Primary school mathematics pre-service teachers, Math learning disability, 2209A Project

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[2] Elementary Mathematics Teaching, Education Faculty, Fırat University, Elazığ, Türkiye, http://orcid.org/0009-0005-2287-8409

[3] Elementary Mathematics Teaching, Education Faculty, Fırat University, Elazığ, Türkiye, http://orcid.org/0009-0000-0668-5280

[4] Elementary Mathematics Teaching, Education Faculty, Fırat University, Elazığ, Türkiye, ekorkmaz@firat.edu.tr, http://orcid.org/0000-0001-6250-3293

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INTRODUCTION

With the 21st century being called the information age and the acceleration of technology-based developments, the basic skills that human profiles in modern societies must have also changed. This change has also been reflected in education. In addition to the acquisition of basic skills in education, skills such as technological literacy, financial literacy, media literacy, and mathematical literacy, which are among the requirements of the modern age, have come to the fore. Mathematical calculations that were previously done using paper and pencil have begun to give way to mathematical skills such as problem solving, estimation, reasoning, creativity, communication, and association. Mathematics contributes to social change and development by forming the basis of scientific and technological developments and supports the intellectual development of individuals. It provides logical, analytical, and creative thinking skills and is often necessary in daily life. In program renewal studies, it has been emphasized that students should be able to apply the mathematical information they learn at school in real life. According to the Noël and Karagiannakis (2022) many students have difficulty in acquiring mathematical knowledge, and especially students with special needs have difficulty in this regard.

According to the Ministry of National Education [MEB] Special Education Services Regulation, individuals who differ from their peers for various reasons are defined as individuals who need special education. Specific learning disabilities include disabilities that arise in the processes necessary to understand and use written or spoken language (MEB, 2018). In the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5), specific learning disabilities are classified as dyslexia (reading disability), dysgraphia (writing disability), and dyscalculia (math learning disability) https://doi.org/10.1176/appi.books.9780890425596.

The term "dyscalculia", derived from the Greek words "dis" meaning disordered or irregular, and "kalulos" meaning pebble or counter, refers to a specific learning disability that primarily affects an individual's capacity to understand and process numerical information. Often referred to as "mathematical learning disability" or "developmental dyscalculia", this condition is characterized by a range of disabilities in acquiring and applying basic mathematical skills and concepts (Karagiannakis et al., 2014; Shafira et al., 2023).

Dyscalculia is a neurological condition that causes individuals to have difficulty understanding numerical concepts and performing mathematical operations (Butterworth and Reigosa, 2007). This condition is independent of general cognitive abilities and is characterized by deficiencies especially in the area of numerical knowledge. Dyscalculia is defined as a student who performs lower in mathematics than the average student despite the absence of factors such as mental retardation, sensory impairment, emotional disorder, and cultural deprivation (Büttner and Hasselhorn, 2011).

Research shows that dyscalculia is a brain-based disorder that occurs due to genetic, neurobiological and environmental factors (Shalev and Von Aster, 2004). Brain imaging and neuroscientific studies have revealed that people with dyscalculia have deficiencies in the

representation and processing of numerical quantities. These deficiencies can be said to be related to numerical representation disorders and changes in brain connections, similar to dyslexia. Dyscalculia is a condition that affects the ability to acquire arithmetic skills, as well as difficulty in understanding simple number concepts. For this reason, individuals who have difficulty performing operations with numbers do what they do mechanically and insecurely, even if they give the correct answer or use the correct method (Department for Education and Skills (DfES), 2001). In addition, it is known that dyscalculia students are approximately two years behind their peers in the strategies they use to solve addition and subtraction operations (Mutlu & Akgün, 2017). Individuals with dyscalculia experience problems with visual and spatial processing, difficulty understanding the concepts of time, finding one's place and direction, understanding daily life problems, and sequencing information and events, as well as mathematical calculations (Alkan-Nurkan & Yazıcı, 2020). Symptoms of dyscalculia may vary from individual to individual; common symptoms include difficulty understanding and calculating the concept of number, spatial disabilities, physical counting with hands, memory disabilities, and disabilities managing time (Aquil & Ariffin, 2020). Another symptom seen in individuals with dyscalculia is number orientation disorder (Baroody et al., 2009). This disorder includes reversing the digits of a given number and not being able to remember what was done before in simple addition (Butterworth & Reigosa, 2007). Recent research has shed light on specific cognitive deficits associated with dyscalculia. Studies have found that adults diagnosed with dyscalculia in childhood exhibit slower performance and greater sensitivity to number magnitude factors when making numerical judgments compared to peers with average or high mathematical skills. These individuals appear to struggle with the mental manipulation and representation of numerical quantities, which may interfere with their ability to make accurate numerical comparisons and estimates. In contrast, these individuals do not show significant differences in their ability to make spatial judgments, suggesting that the core deficit in dyscalculia may be specific to numerical processing rather than a general cognitive impairment. This dissociation between numerical and spatial processing skills suggests that dyscalculia may result from domain-specific deficits in the representation and processing of numerical information rather than a broader cognitive dysfunction (Mazzocco et al., 2011).

Among children with learning disabilities, those who have difficulty learning mathematics may encounter various problems in developing number sense, performing arithmetic operations, and perceiving and learning mathematical concepts (Butterworth, 2003; Mutlu, 2016). These children may have difficulty solving problems using basic mathematical skills, may have a delay in acquiring number sense, and may continue to count with fingers even though their peers have long since given up. They may also have disabilities in many areas related to mathematics, such as difficulty comparing numbers, making frequent mistakes, difficulty learning and drawing simple geometric shapes, difficulty understanding the concept of time, weakness in the sense of place and direction, difficulty calculating money in daily shopping and calculating change (Akın & Sezer, 2010).

Developmental dyscalculia is a learning disorder affecting the acquisition of school-level arithmetic skills, found in approximately 3–6% of the population. At a behavioral level, dyscalculia is characterized by poor retrieval of arithmetic facts from memory, use of immature

calculation procedures and counting strategies, and atypical representation and processing of numerical magnitude (Košč, 1974). Emerging evidence suggests that dyscalculia is associated with atypical structure and function in brain regions involved in the representation of numerical magnitude. The current state of knowledge points to a fundamental deficit in numerical magnitude representation as the underlying cause of dyscalculia, but further research is needed to elucidate the causal mechanisms of this disorder (Košč, 1974; Landerl et al., 2013).

In summary, dyscalculia is a complex learning disability characterized by a range of disabilities in acquiring and applying basic mathematical skills and concepts. Although the core deficit appears to be specific to numerical processing, the manifestation of dyscalculia may be influenced by a variety of comorbid factors, highlighting the need for a comprehensive understanding of the condition and the development of targeted interventions.

Purpose of the Study

The purpose of this study is to reveal the knowledge and opinions of primary school mathematics pre-service teachers about dyscalculia students who have difficulty learning mathematics and to gather information about what can be done for students who may be in the dyscalculia risk group.

Research Problem

It has been determined according to the research that primary school mathematics pre-service teachers are willing and enthusiastic to teach dyscalculia students but they do not have full knowledge about how to teach and which methods to use. In this context, it can be concluded that primary school mathematics pre-service teachers need the necessary support. Within the scope of the research, it is among the main goals for primary school mathematics pre-service teachers to be aware of dyscalculia and to know how to behave towards this group. In addition, informing primary school mathematics pre-service teachers about the dyscalculia awareness they need, raising their awareness, making dyscalculia students love mathematics with materials and educational games, and pre-service teachers creating a brainstorming and discussion environment among themselves on the subject are among our main goals. In this direction, the research problem was determined as; "What do primary school mathematics teachers know about dyscalculia risk groups and do pre-service teachers know how to behave when they encounter a student who may be in this risk group?"

Importance of the Study

The education of dyscalculia students according to the education programs prepared for average level students leads them to academic failure. Therefore, new education programs should be organized for dyscalculia students. The attitudes of their teachers are among the biggest factors in dyscalculia students losing their belief that they can learn mathematics. It has been revealed by different studies that primary school mathematics pre-service teachers do not have sufficient information about dyscalculia and do not know what to do with students in the dyscalculia risk group. Therefore, it is important to restructure special applications that can be made for dyscalculia students in education faculties and to increase the pedagogical knowledge of primary school mathematics pre-service teachers on the subject.

Teachers have a major role in both the preparation and implementation of teaching materials. The most effective material of teaching programs is the activities prepared by teachers. In this context, it can be said that the teaching programs and textbooks developed are activity-based. Therefore, it is important to focus on how learning activities are structured, what features they should include, and how they should be designed. Therefore, this study is considered important because it is aimed at increasing the skills and competencies of pre-service teachers in the process of developing activities for dyscalculia students.

METHOD

Research Design

This study investigated the views of primary school mathematics pre-service teachers on dyscalculia students and their knowledge on how to behave when they encounter this group. This study was designed based on the qualitative research method and phenomenology design. Phenomenological design is a qualitative research approach that seeks to deeply understand individuals' lived experiences and the meanings they attribute to a particular phenomenon. This method focuses on uncovering the essential structures (eidos) of human experiences through in-depth exploration (Smith et al., 2009). The qualitative research method require that the data obtained on a specified topic be examined in detail without any manipulation and that the findings be supported through one-to-one quotations (Yıldırım and Şimşek 2011). This study, in which the qualitative research method and content analysis technique will be used, enables an in-depth analysis of opinions, thoughts or facts on a specified topic (Creswell 1998; Yıldırım and Şimşek, 2011).

Participants

The study group of the research consists of a total of 66 volunteer pre-service teachers studying in the Department of Primary Mathematics Teaching at Fırat University, Faculty of Education, in the fall semester of the 2024-2025 academic year. 29.2% of these candidates are first-year students, 44.6% are second-year students, 23.1% are third-year students, and 3.1% are fourth-year students. In addition, 49 of the pre-service teachers participating in the study are female and 17 are male.

Data Collection

A semi-structured opinion form prepared with the help of expert opinions was used as the data collection tool in this study. The questions of the semi-structured opinion form are given below.

1. What is mathematics learning disability?

2. What do you think about the reasons for mathematics learning disability?

3. How do you recognize a student with mathematics learning disability? (From which characteristics)

4. How can a suitable classroom environment be designed for your student with mathematics learning disability?

5. What should be considered when planning the teaching process for a student with mathematics learning disability?

6. Which methods/techniques and materials should be used for students with mathematics learning disability in the learning-teaching process?

7. What should be the course evaluation processes of students with mathematics learning disability?

8. Do you find yourself sufficient in terms of mathematics learning disability? Explain why.

The semi-structured opinion form used in this study was developed by the researcher to collect in-depth qualitative data on teachers' perceptions of mathematics learning disability. The initial draft of the form was prepared based on a comprehensive review of the relevant literature on mathematics learning difficulties and dyscalculia.

After the draft was prepared, the form was submitted to three field experts for content validation: one expert in mathematics education, one in special education, and one in educational sciences. These experts reviewed the questions in terms of clarity, relevance, and appropriateness to the research objectives. Based on their feedback, minor revisions were made to improve the wording and ensure conceptual clarity.

As a result, the final version of the semi-structured opinion form consisted of eight open-ended questions designed to explore teachers' definitions, perceptions, instructional practices, and self-efficacy related to mathematics learning disability.

Data Analysis

Validity

To ensure the validity of the study, multiple strategies were employed. Inter-coder agreement was established by having two independent researchers perform the coding and thematic analysis, thereby minimizing subjective bias. Discrepancies in coding were resolved through iterative discussions until a consensus was reached, enhancing internal consistency. Furthermore, direct quotations from pre-service teachers were included to preserve the authenticity of their voices, thereby supporting credibility (Lincoln & Guba, 1985). External validity was further strengthened by providing thick descriptions of the research context and participant responses, which allow readers to determine the transferability of the findings to similar educational settings (Creswell & Poth, 2018).

Reliability

To ensure the reliability of the research, the data obtained from the semi-structured opinion forms were subjected to systematic content analysis through themes, categories, and codes determined by the researchers. Two independent researchers conducted the coding and content analysis to enhance consistency. Any differences in the codes generated during the process were discussed and reconciled to reach a common understanding. Additionally, a detailed audit trail documenting each stage of the analysis, including theme development and code

definitions, was maintained to strengthen dependability and transparency throughout the research process.

Ethics Declaration

Ethics approval was granted by Fırat University ethics board with approval number 23952.

FINDINGS

This section includes the findings obtained from the research data. The analysis of the data for the first question, "What is Mathematics Learning Disability" in the semi-structured opinion form is given below.

Table 1. *Views on mathematics learning disability*

Theme	Category	Code	N
Mathematics Learning Disability	Learning disability	From an operational perspective	T1, T2, T4, T16, T20, T9, T26, T27, T29, T31, T54, T65
		Conceptually	T7, T21, T22, T23, T25, T37, T40, T48, T52, T59, T60, T61, T64, T42, T44, T51, T58, T62, T63
	Just give the name	Dyscalculia	T3, T5, T6, T8, T10, T11, T12, T13, T14, T15, T17, T18, T19, T24, T28, T30, T32, T33, T34, T35, T36, T38, T39, T41, T43, T45, T46, T47, T49, T50, T53, T55, T57

When Table 1 is examined, the theme of the pre-service teachers' views on mathematics learning disabilities consists of 2 categories. There are 31 people in the learning disability category. There are 19 pre-service teachers who think that mathematics learning disability is a conceptual difficulty. On the other hand, there are 12 people who think that it is a procedural difficulty. There are 33 people who only give the name Dyscalculia. In this respect, it can be said that almost all of the pre-service teachers have knowledge about mathematics learning disabilities. A total of 64 out of 66 pre-service teachers who participated in the research responded. Some quotation sentences are given below.

"Any individual's mathematical skills are behind their peers and they have difficulty learning the subjects." (T16).

"It is a learning disorder that causes difficulty in understanding numbers and symbols, making mathematical calculations and making connections." (T23)

"It is the student's difficulty in four operations and not being able to distinguish numbers." (T65).

The analysis of the data for the second question, "What do you think about the reasons for the occurrence of mathematics learning disabilities?" in the semi-structured opinion form is given below.

Table 2. *Reasons of mathematics learning disability*

Theme	Category	Code	N
Reasons for Mathematics Learning Disability	The narrator factor	Teacher	T1, T60, T64
	Later realization	Getting used to ready-made information	T6, T19, T29
		Inequality of opportunity and inadequate education	T2, T5, T21, T39, T44, T49, T32, T33, T34, T12, T14, T24, T26, T42, T48, T51, T60
	Congenital	Genetic elements	T3, T4, T7, T9, T11, T15, T16, T17, T18, T22, T23, T27, T35, T37, T38, T43, T54, T56, T58, T59
		Developmental delay	T8, T10, T20, T36, T40, T52, T57, T60, T6
	Environmental Factors	Family	T41, T46
		Environment	T31, T45, T50, T51, T53, T55, T62, T63, T65

When Table 2 is examined, it is seen that the theme of the reasons for the development of mathematics learning disabilities is divided into 4 categories. 3 people in the narrator factor category who thought that mathematics learning disabilities occurred due to the teacher, while they stated that being focused on ready information and laziness could be the reason. The remaining pre-service teachers (20), whose main reason may be due to such situations, attributed it to the conditions and circumstances that developed later. 20 views received from pre-service teachers showed that they knew that this difficulty was innate related to genetics. It was also seen that 9 of them attributed it to the retardations experienced during the development process of the person. Those who thought that mathematics learning disabilities occur due to genetics are the majority. 11 of the pre-service teachers claimed that this situation occurred due to the family and environment. A total of 63 out of 66 pre-service teachers who participated in the research responded. The views regarding the obtained data are as follows:

"It may be due to the teacher who teaches mathematics." (T1).

"People are getting used to technology and ready-made information and therefore they reduce the act of thinking to a minimum level." (T2).

"It may be due to the lack of self-confidence created by the family and the environment and the fear of mathematics." (T50).

"Everything from the environment in which the person is taught to his/her genetic characteristics and experiences may affect it." (T51).

"There may be a mental retardation. In addition, it may differ from his/her peers because of the educators who provide education or the inadequacy of the educational environment." (T60).

The analysis of the data for the third question in the semi-structured opinion form; "How do you recognize students with learning disabilities in mathematics?" is given below.

Table 3. *Identifying students with mathematics learning disability*

Theme	Category	Code	N
Identifying Students with Mathematics Learning Disabilities	Difficulty	Computational difficulty	T1, T14, T20, T27, T31, T37, T51, T56, T62, T63
		Conceptual difficulty	T7, T15, T16, T17,T30, T35, T47, T50,T52, T55
	Readiness	Comparison with peers	T9, T26, T36, T45 T3, T10, T24, T32, T33, T38, T39, T42, T49, T58, T64, T65
	Counting Skills	Counting with fingers	T4, T6, T43, T46, T53
		Inability to Count backwards	T13, T19, T34, T57
	Perception of Time	Failure to understand analog clock	T28, T40, T48
	Academic Success	Exam results	T2, T18
		Class participation	T5, T8, T11, T12, T22, T23, T25,T44, T54, T59, T60

When Table 3 is examined, it is seen that the theme of recognizing students with learning disabilities in mathematics is divided into 5 categories as difficulty, readiness, difficulty in counting, time perception and academic success. When we look at the difficulty category, 20 of the pre-service teachers stated that the operational or conceptual difficulty of students with learning disabilities in mathematics is a determining feature. In the readiness category, 16 pre-service teachers emphasized that inferences can be made by looking at the student's behavior or the level difference with their peers. When it comes to the counting skills category, while emphasizing the students' inadequacies in counting (counting with fingers, not being able to count backwards), 3 pre-service teachers mentioned that these students do not have a sense of time and cannot read an analog clock. In addition, there are statements that in terms of academic success (reluctance to participate in the lesson and exam results can also indicate this risky group). A total of 61 out of 66 pre-service teachers who participated in the research responded. The opinions of some pre-service teachers on the subject are as follows:

"His/Her lack of interest in class, misunderstanding and answering questions in exams." (T8).

"He has difficulty counting backwards rhythmically." (T34).

"His/Her being far behind students expected to be at the same level in the same class." (T49).

"His/Her difficulty in counting, adding, subtracting, and calculating change." (T62)

"His/Her attitude in class and the low grades he gets in exams." (T18)

The analysis of the data for the fourth question, "How can an appropriate classroom environment be designed for students with learning disabilities in mathematics?" in the semi-structured opinion form is given below.

Table 4. *Preparing a classroom environment for students with mathematics learning disabilities*

Theme	Category	Code	N
Preparing a Classroom Environment for Students with Mathematics Learning Disabilities	Creating an Activity	Daily life examples	T20, T35, T42, T52
		Using images	T1, T17, T23, T27, T64
		Using materials	T3, T4, T7, T9, T10, T31, T36, T37, T43, T44, T46, T48, T59, T62, T63
	Individual Education	Personalized program	T6, T11, T12, T38, T53, T36, T58
		One-on-One attention	T2, T8, T19, T21, T25, T26, T28, T29, T30, T39, T45, T57
	Special Classes	On an equal footing	T14, T15, T32, T33, T34, T40, T41, T50
		In line with the opinions	T13, T16, T49, T51, T60

When Table 4 is examined, it is seen that there are 3 different categories under the theme of preparing a classroom environment for students with learning disabilities in mathematics. In the activity creation category, most of the pre-service teachers emphasized that materials should be provided in the classroom environment. In addition, it was stated that it would be important to use visuals in the classroom and give examples from daily life. When it comes to the individual education category, there are 19 people who think that a program should be prepared for students with learning disabilities in mathematics or that students should be dealt with one-on-one. While 13 of the pre-service teachers stated that special classes should be created for students at risk of dyscalculia, 8 of them emphasized that these classes should consist of students of equal level and that it would be healthier to prepare these classes by taking the students' opinions into account (5). A total of 56 out of 66 pre-service teachers who participated in the research responded. Some of the pre-service teachers' opinions on the subject are as follows:

"One-on-one attention can be provided outside the classroom, at school." (T28)

"By bringing together students who suffer from the same problem and designing a classroom that is planned according to their needs." (T14).

"They should be able to receive education with their friends at school, and separate classes where they can receive private education should be prepared by taking into account different opinions." (T51).

"By preparing appropriate materials and an individualized learning program." (T36).

"Concrete examples can be hung on the walls, and tools that will make the subject concrete can be brought into the classroom environment." (T64).

The analysis of the data for the fifth question, "What should be taken into consideration when planning the teaching process of a student with learning disabilities in mathematics?" in the semi-structured opinion form is given below.

Table 5. *Factors to consider when planning the teaching process*

Theme	Category	Code	N
Factors to Consider When Planning the Teaching Process	Student Suitability	Personal characteristics	T1, T2, T3, T14, T43, T47, T56, T60
		Cognitive level	T4, T5, T8, T12, T16, T19, T20, T23, T36, T37, T40, T41, T42, T55, T58, T59
		From a psychological perspective	T10, T13, T25, T29, T33, T49, T52
	For Parents	Parental approval	T11
		Parent cooperation	T57
	Teaching Process	Different teaching methods	T17, T24, T26, T28, T31, T48, T54, T18, T27, T30, T38, T45, T50

When Table 5 is examined, it is seen that there are 3 different categories in the theme of the elements to be considered when planning the teaching process for students with learning disabilities in mathematics. In the category of suitability for students, 8 people stated that the personal characteristics of the student should be used in the planning phase of the teaching process, 16 people stated that the cognitive level should be used, and 7 people stated that the psychological level should be used. In the category of suitability for parents, 1 person emphasized that parental approval should be obtained, and 1 person emphasized that parental cooperation should be taken into consideration. In the category Teaching Process, 13 person emphasized that different teaching methods should be taken into consideration. One-to-one quotes regarding the views of some pre-service teachers are given below:

"The student's personal characteristics and the research conducted on this subject." (T14)

"It should not be ignored that his/her level is lower than his/her other friends." (T59)

"The necessary evaluations can be made without breaking the student's self-confidence and without isolating him/her from other students." (T25)

"Permission should be obtained from the family." (T11)

"First, it should be determined that the student is having disabilities and a study should be conducted with the family." (T57).

"Simple operations can be explained using various models." (T31)

"Both without being completely separated from his/her friends and by preparing a separate IEP program, he/she can be ensured to continue his/her education." (T45)

The analysis of the data for the sixth question in the semi-structured opinion form; "Which methods/techniques and materials should be used for students who have difficulty learning mathematics in the teaching-learning process?" is given below.

Table 6. *Opinions on the methods/techniques and materials to be used*

Theme	Category	Code	N
Methods/Techniques and Materials to be Used	Concrete Teaching	Materials	T2, T3, T5, T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T17, T19, T20, T22, T23, T26, T27, T28, T29, T30, T31, T32, T33, T34, T35, T36, T37, T38, T39, T40, T50, T51, T52, T53, T54, T55, T57, T58, T59, T61, T62, T63
		Examples	T21, T42
		Games	T24
	Technology Supported Instruction	Artificial intelligence	T25
	Teaching Methods	Constructivist teaching	T1, T49
		Indıvıdualized education programme	T4, T18, T56, T60

When Table 6 is examined; It is seen that there are 3 different categories in the theme of which methods/techniques and materials should be used for students with mathematics learning disabilities in the learning-teaching process. In the concrete teaching category, 46 people thought that concrete materials should be used, 2 people thought that examples should be used, and 1 person thought that games should be used. In the technology-supported teaching category, 1 person thought that artificial intelligence should be used. In the teaching methods category, 2 people thought that constructivist teaching should be used, and 4 people thought that Indıvıdualized education programme should be used. One-to-one quotes from some pre-service teachers are given below:

"To ensure that the child interacts with concrete objects such as cubes, blocks, counting sticks or apples and pears for addition and subtraction, and learns by touching them. To play games." (T57)

"The child's interest should be drawn to examples from daily life" (T42)

"Artificial intelligence and mathematics teaching blocks, animations and with the help of technology" (T25)

"Constructivist education should be provided." (T1)

"One-on-one and individual-appropriate education programs should be provided." (T4)

The analysis of the data for the seventh question in the semi-structured opinion form; "How should the course evaluation processes of students with learning disabilities in mathematics be?" is given below.

Table 7. *Opinions on course evaluation processes*

Theme	Category	Code	N
Course Evaluation Process	Student Specific Evaluation	Superficial evaluation	T1, T17, T20, T21, T37, T44, T57, T60
		Level of difficulty	T8, T12, T19, T23, T50, T56, T61
		Individual evaluation	T3, T4, T6, T7, T9, T14, T24, T26, T27, T30, T31, T36, T38, T39, T40, T43, T45, T46, T47, T52, T55, T53, T65
	Using Different Assessment Methods	With positive reinforcement	T5, T13, T28, T42, T62, T63, T10, T16, T33, T35, T49
		Follow closely	T15, T48
		In concrete terms	T11
		Evaluation analysis	T22
		With events applied evaluation	T54
		Individual education programme	T18

When Table 7 is examined; it is seen that there are 2 different categories in the theme of the course evaluation process for students with learning disabilities in mathematics. More than half of these are student-specific evaluations. It was stated that the student should be evaluated superficially, according to the level of difficulty, individually and through close monitoring, supported with reinforcements in this process, the evaluation process should be done by motivating the child and the evaluation should be done based on the student's progress level in the course. In the category of using different evaluation methods,

1 person said that the evaluation should be done using the individualized education program (IEP), 1 person said that the evaluation should be done with activities, 1 person said that an applied evaluation should be done, 2 people said that an evaluation should be done by increasing the comprehensibility with concrete concepts and 1 person mentioned that the evaluation can be shaped by making the necessary analyses after the evaluation. One-to-one quotes regarding the opinions of some pre-service teachers are given below:

"It should be more flexible compared to other students." (T44)

"It should be done according to their own learning levels, unlike other students." (T43)

"In addition to other students, their learning progress should be closely monitored." (T16)

"It should be with small activities." (T22)

The analysis of the data for the eighth question in the semi-structured opinion form; "Do you find yourself competent in terms of learning mathematics disabilities? Explain why?" is given below.

Table 8. *Opinions of pre-service teachers about their competencies*

Theme	Category	Code	N
Opinions of Pre-service Teachers about their Competencies	Insufficient	Feeling inadequate	T1, T3, T7, T15, T17, T18, T23, T27, T35, T37, T39, T40, T41, T45, T46, T51, T53, T56, T61, T65
		In general knowledge	T2
		Can be improved	T10, T13, T14, T22, T30, T47, T48, T55, T59, T60
		Inexperience	T9, T28, T36
	Sufficient	Contribution of the presentation	T8, T31, T32, T33, T34, T49, T50
		Feeling adequate	T4, T5, T6, T12, T16, T19, T20, T21, T24, T25, T26, T29, T38, T42, T43, T44, T52, T54, T57, T58, T62, T63, T64
		Experience	T35

When Table 8 is examined; it is seen that there are 2 different categories in the theme of the views of the pre-service teachers about their competence. There are 34 views in the category of inadequate. Feeling inadequate (20), 1 person stated that they have general knowledge, they need to improve themselves because they do not feel fully competent (10), and 3 people stated that they find themselves inadequate because they are inexperienced. The views in the category of sufficient are (7) felt competent after the contribution of the presentation, 23 people stated that they had sufficient knowledge about mathematics learning disabilities. 1 person found himself competent because he had experience. One-to-one quotes from some pre-service teachers are given below:

"I don't find my knowledge sufficient, I just learned what it is." (T27)

"I don't think it's a difficulty that can be easily noticed by well-known educators in our country. I have a general amount of knowledge." (T2)

"I think I need to improve myself. Of course I have some shortcomings." (T60)

"I don't find myself fully sufficient because I've never come across anyone with dyscalculia. I don't think I'll be sufficient without working with them." (T36)

"I find it more sufficient with this conference." (T31)

"I trust myself in this regard because my brother also has dyslexia." (T35)

DISCUSSION and CONCLUSIONS

In the light of the findings obtained from the research data, the views of the pre-service teachers about the difficulty in learning mathematics were determined as learning disabilities, conceptual disabilities and operational disabilities. In this respect, it can be said that almost all of the pre-service teachers have knowledge about the difficulty in learning mathematics. The reasons for the occurrence of the difficulty in learning mathematics were determined as knowing that it is innate, the delays experienced in the development process and the conditions and circumstances that develop later. They also stated that the narrator factor, the students being focused on ready information and laziness could also be the reason. On the other hand, the majority of those who think that the difficulty in learning mathematics occurs due to

genetics are the majority. A small number of the pre-service teachers claimed that this situation occurs due to family and environment.

It was seen that 5 different categories were formed under the theme of recognizing students with difficulty in learning mathematics, namely difficulty, readiness, difficulty in counting, time perception and academic success. 20 of the pre-service teachers stated that the difficulty in learning mathematics is a determining feature for students with difficulty in learning mathematics, whether it is operational or conceptual. In the category of readiness, 16 pre-service teachers emphasized that inferences can be made by looking at the student's behavior or the level difference with their peers. When it comes to the counting skills category, while focusing on the students' inadequacies in counting (counting with fingers, not being able to count backwards), 3 pre-service teacher teachers mentioned that these students do not have a sense of time and cannot read an analog clock. In addition, there are statements that academic success (reluctance to participate in the lesson and exam results can also indicate this risk group). The theme of preparing a classroom environment for students with learning disabilities in mathematics includes creating activities, having materials, using visuals in the classroom and giving examples from daily life. In addition, when it comes to the individual education category, there are 19 people who think that special programs should be prepared for students with learning disabilities in mathematics or that students should be dealt with one-on-one. While 13 of the pre-service teacher teachers stated that special classes should be created for students at risk of dyscalculia, 8 of them emphasized that these classes should consist of students of equal level and that it would be healthier to prepare these classes by taking the students' opinions into account (5).

As shown in the question of which method/technique and materials should be used for students with learning disabilities in mathematics; concrete teaching, concrete materials, examples and games should be used were the answers supporting the view. In addition, it is stated that artificial intelligence should be used in the technology-supported teaching category. In the teaching methods category, they thought that constructivist teaching and Individualized teaching program (IEP) should be used. In the theme of the course evaluation process for students with learning disabilities in mathematics, more than half of the pre-service teachers are in the evaluation category specific to the student. It is stated that the student should be evaluated superficially, in accordance with the level of difficulty, individually and through close monitoring, that the evaluation process should be carried out by motivating the child in this process and that the evaluation should be made based on the student's progress level in the lesson. In the category of using different evaluation methods, it was mentioned that individualized education program (IEP), evaluation should be done with activities, one-person practical evaluation should be done, an evaluation should be done by increasing the comprehensibility with concrete concepts and the evaluation can be shaped by making the necessary analyses after the evaluation. Finally, when the pre-service teachers' opinions about their competence in this subject were asked, it was seen that the numbers of sufficient (34) and insufficient (31) were very close to each other. The main reasons for feeling insufficient include having general (superficial) knowledge, thinking that they need to improve themselves, feeling

inexperienced. The opinions in the sufficient category include the contribution of the presentation, feeling sufficient and 1 person having experience because of their sibling.

When the literature studies on this subject are examined; Previous studies have revealed that teachers have a lack of knowledge about mathematics learning disabilities, have misconceptions, have partial knowledge about the characteristics of these students, do not have a foresight on how to detect and eliminate mathematics disabilities, do not have sufficient experience in intervention strategies for these children, and do not have self-confidence (Alkan-Nurkan & Yazıcı, 2020; Chideridou-Mandari et al., 2016; Kizilelma, 2023; Kuruyer et al., 2019; Mutlu et al., 2022). These findings support the study.

Dyscalculia, a specific learning disability characterized by significant disabilities in understanding and processing numerical information, has been the subject of extensive research in recent years. Emerging evidence suggests that dyscalculia is associated with atypical structure and function in the brain regions responsible for numerical magnitude representation (Košč, 1974). The current state of knowledge points to a fundamental deficit in numerical magnitude representation as the primary mechanism underlying dyscalculia (Košč, 1974). Adults diagnosed with dyscalculia in childhood have been found to be slower and more influenced by factors related to number magnitude, such as the spacing of number triplets or the distance between the middle number and the true arithmetic mean, when making numerical judgments, compared to peers with average or high mathematical skills (Mussolin et al., 2011). This suggests that dyscalculia patients have fundamental disabilities in processing numerical information and representing numerical magnitudes. These findings are also known by pre-service teachers.

In the literature, it has been stated that these students have problems in processing numbers and quantities, basic arithmetic operations, creating simple geometric shapes, estimation skills, taking and giving change, visual-spatial concepts, mathematical reasoning, understanding time and calendar, and that their mathematical memories are weak (Haberstroh and Schulte-Körne, 2019; Sezer and Akın 2011). When the opinions of classroom teachers were obtained about the methods that students with learning disabilities in mathematics should follow in the teaching processes, it was seen that teachers generally recommended methods such as individual education, use of materials, teaching according to the student, teaching through games, and peer support. Literature cites similar arguments with pre-service teachers and recommend appropriate methods for students with learning disabilities in mathematics. Devisri and Tharani (2021) emphasized the necessity of using game methods and providing real-life examples for children with learning disabilities in mathematics, but they also stated that modern technology should be used in the education of these children. The fact that classroom teachers do not refer to the use of technology for learning disabilities in mathematics can be interpreted as their unawareness of programs specially prepared for these children. It has also been observed that teachers who advocate the use of materials do not mention materials such as dot cards specially designed for these children. It has also been observed that methods such as spiral curriculum, sequential strategy (concrete-semi-abstract-symbol) direct instruction method and teaching with fingers (Hacısalihoğlu-Karadeniz, 2013), which are frequently mentioned in the literature for students with learning disabilities in mathematics, are not mentioned by the teachers. This

situation shows that teachers do not have sufficient understanding in organizing appropriate educational environments and determining approaches that will help students with learning disabilities in mathematics learn mathematics. However, since it has been determined that the mathematical skills of children with learning disabilities in mathematics are improved and the problems they encounter are reduced with the educational interventions made (Nagavalli, 2015), teachers need to have information about the right intervention methods to support these students. These findings are also parallel to the study conducted. As a matter of fact, as stated by primary school mathematics pre-service teachers, more concrete materials, games and visual support should be provided to dyscalculia risk groups.

Recommendations

It is important for individuals with learning disabilities to analyze the mathematical concepts and skills to be taught in daily plans prepared in line with short-term goals and to implement appropriate instructional practices. It is known that the practice that started with ındıvıdual education programme reached its final goal with ındıvıdual education programme (Mutlu, 2016).

Studies have shown that 1% of school-age children may be in the dyscalculia risk group. It is necessary to determine why these students with dyscalculia have difficulty in mathematics and the points where they have difficulty. At this point, the importance of teachers' opinions is great in the evaluation and development process of education systems (Cooney and Shealy, 1997). There are many studies conducted on learning disabilities based on teachers' opinions (Alghazo and Naggar Gaad, 2004; Saravanabhavan and Saravanabhavan, 2001; Wadlington and Wadlington, 2006). The functionality of the curriculum for teaching any course and the deficiencies in the program should be evaluated according to teachers' opinions. It is important to measure the knowledge level of primary school mathematics pre-service teachers about dyscalculia for the academic, physical and social development of dyscalculia students. As a result of the measurements, it should be ensured that they have the necessary equipment in the points found to be insufficient about dyscalculia. It is thought that it will be beneficial for primary school mathematics teachers to receive expert help regarding dyscalculia students. Thus, it is thought that dyscalculia individuals will reach the desired point in education and achieve individual satisfaction with the support of their teachers. Therefore, it is recommended that especially primary school mathematics pre-service teachers and classroom teachers should be informed more about the subject and that joint projects should be carried out with the help of institutions and organizations where pre-service teachers can gain experience.

REFERENCES

Akın, A., & Sezer, S. (2010). Diskalkuli: Matematiksel öğrenme bozukluğu [Dyscalculia: A mathematical learning disorder]. *Bilim ve Aklın Aydınlığında Eğitim, (126–127),* 41–48.

Alghazo, M. E., & Naggar Gaad, E. E. (2004). General education teachers in the United Arab Emirates and their acceptance of the inclusion of students with disabilities. *British Journal of Special Education, 31*(2), 94–100. https://doi.org/10.1111/j.0952-3383.2004.00335.x

Alkan Nurkan, M., & Yazıcı, E. (2020). Matematik öğretmenlerinin matematik öğrenme güçlüğü (diskalkuli) farkındalıklarının belirlenmesine ilişkin bir durum çalışması [A case study on determining mathematics teachers' awareness of mathematical learning difficulties (dyscalculia)]. *Çağdaş Yönetim Bilimleri Dergisi [Journal of Contemporary Administrative Sciences]*, *7*(1), 95–109.

Aquil, M. A. I., & Ariffin, M. M. (2020). The causes, prevalence and interventions for dyscalculia in Malaysia. *Journal of Educational and Social Research*, *10*(6), 279–289. https://doi.org/10.36941/jesr-2020-0126

Baroody, A. J., Eiland, M., & Thompson, B. (2009). Fostering at-risk preschoolers' number sense. *Early Education and Development*, *20*(1), 80–128. https://doi.org/10.1080/10409280802206619

Butterworth, B. (2003). *Dyscalculia screener: Highlighting pupils with specific learning disabilities in maths.* London: Nelson Publishing Company.

Butterworth, B., & Reigosa, V. (2007). Information processing deficits in dyscalculia. In D. B. Berch & M. M. M. Mazzocco (Eds.), *Why is math so hard for some children? The nature and origins of mathematical learning disabilities and disabilities* (pp. 65–81). Baltimore, MD: Paul H. Brookes Publishing Co.

Büttner, G., & Hasselhorn, M. (2011). Learning disabilities: Debates on definitions, causes, subtypes, and responses. *International Journal of Disability, Development and Education, 58*, 75–87.

Chideridou–Mandari, A., Padeliadu, S., Karamatsouki, A., Sandravelis, A., & Karagiannidis, C. (2016). Secondary mathematics teachers: What they know and don't know about dyscalculia. *International Journal of Learning, Teaching and Educational Research, 15*(9), 84–98.

Cooney, T. J., & Shealy, B. E. (1997). On understanding the structure of teachers' beliefs and their relationship to change. In E. Fennema & B. S. Nelson (Eds.), *Mathematics teachers in transition* (pp. 87–109). Mahwah, NJ: Erlbaum.

Creswell, J. W. (1998). *Qualitative inquiry and research design: Choosing among five traditions*. Thousand Oaks, CA: Sage Publications.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th Ed.). Thousand Oaks, CA: Sage.

Department for Education and Skills (DfES). (2001). *Guidance to support pupils with dyslexia and dyscalculia.* Retrieved from https://scotens.org/sen/resources/dyslexia_leaflet_maths.pdf

Devisri, K., & Tharani, S. (2021). An effect of mathematical intervention strategies for dyscalculia students. *Journal of Language and Linguistic Studies*, *17*(4), 3496–3500.

Geary, D. C., Hoard, M. K., Byrd-Craven, J., & DeSoto, M. C. (2004). Strategy choices in simple and complex addition: Contributions of working memory and counting knowledge for children with mathematical disability. *Journal of Experimental Child Psychology, 88*(2), 121–151.

Haberstroh, S., & Schulte-Körne, G. (2019). The diagnosis and treatment of dyscalculia. *Deutsches Ärzteblatt International, 116*(7), 107–114. https://doi.org/10.3238/arztebl.2019.0107

Hacısalihoğlu Karadeniz, M. (2013). Diskalkuli yaşayan öğrencilere ilişkin öğretmen görüşlerinin değerlendirilmesi [Teachers' opinions on students experiencing dyscalculia]. *Education Sciences, 8*(2), 193–208.

Karagiannakis, G., Baccaglini-Frank, A., & Papadatos, Y. (2014). Matematiksel öğrenme güçlükleri alt tiplerinin sınıflandırılması [Classification of subtypes of mathematical learning difficulties]. *Frontiers in Human Neuroscience, 8*. https://doi.org/10/fnh.2

Kizilelma, T., Bağdat, O., & Taştepe, M. (2023). Sınıf öğretmenlerinin matematikte öğrenme güçlüğü çeken öğrencilerle ilgili farkındalıkları, zorlukları ve önerileri [Primary school teachers' awareness, challenges, and suggestions about students with learning difficulties in mathematics]. *Shanlax International Journal of Education, 11*(S1). https://doi.org/10/ed.v11i-Ekim.6661

Košč, L. (1974). Gelişimsel diskalkuli [Developmental dyscalculia]. *Journal of Learning Disabilities, 7*(3), 164. https://doi.org/10/00222

Kuruyer, H. G., Çakıroğlu, A., & Özsoy, G. (2019). İlkokul öğretmen adaylarının okuma ve matematik güçlüklerine ilişkin pedagojik farkındalıklarının ve öğretimsel bakış açılarının belirlenmesi [Determining preservice primary teachers' pedagogical awareness and instructional perspectives on reading and mathematical difficulties]. *Kastamonu Education Journal, 27*(4), 1.

Landerl, K., Göbel, S. M., & Moll, K. (2013). Gelişimsel diskalkulinin temel eksikliği ve bireysel belirtileri: Eşlik eden hastalıkların rolü [Core deficit and individual symptoms of developmental dyscalculia: The role of comorbidities]. *Trends in Neuroscience and Education, 2*(2), 3. https://doi.org/10.1016/j.tine.2013.06

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Sage.

Mazzocco, M. M. M., Feigenson, L., & Halberda, J. (2011). Yaklaşık sayı sisteminin bozuk keskinliği, matematiksel öğrenme güçlüğünün (diskalkuli) altında yatar [Impaired acuity of the approximate number system underlies mathematical learning disability (dyscalculia)]. *Child Development, 82*(4). https://doi.org/10.1111/j.1467-8624.x

Milli Eğitim Bakanlığı [MEB]. (2018). *Özel eğitim hizmetlerinin yönetilmesi [Management of special education services]*.

Mussolin, C., Martin, R., & Schiltz, C. (2011). Diskalkulisi olan ve olmayan yetişkinlerde sayı ve uzay işleme arasındaki ilişkiler [Relationships between number and space processing in adults with and without dyscalculia]. *Acta Psychologica, 138*(1), 19. https://doi.org/10.1016/j.actpsy.2011.06.0

Mutlu, Y. (2016). *Bilgisayar destekli öğretim yapısının MÖG'de yaşayan sayıların anlaşılması üzerindeki etkilerinin incelenmesi [Examining the effects of computer-assisted instruction structure on understanding numbers with mathematical learning difficulties*] [Unpublished PhD Thesis].

Mutlu, Y., Çalışkan, E. F., & Yasul, A. F. (2022). Öğretmenlere sorduk: Diskalkulinin ne olduğunu biliyor musunuz? [We asked teachers: Do you know what dyscalculia is?] International Online Journal of Primary Education (IOJPE), 11(2), 361–378.

Mutlu, Y., & Akgün, L. (2017). Matematik öğrenmenin güçlüğünün tanınmasında yeni bir model: Çoklu süzgeç model [A new model for recognizing mathematical learning difficulties: The multiple filter model]. *İlköğretim Çevrimiçi, 16*(3). https://doi.org/10.1/ilk.20

Nagavalli, T. (2015). *Salem bölgesindeki diskalkuli ilkokul çocukları üzerine bir çalışma ve yenilikçi stratejilerin telafi edici önlemler olarak uygulanabilirliğinin değerlendirilmesi [A study on dyscalculic primary school children in the Salem region and evaluation of innovative strategies as remedial measures]*. Department of Educational Research and Policy Perspectives, India.

Noël, M. P., & Karagiannakis, G. (2022). *Matematikte diskalkuli ve öğrenme güçlükleri için etkili öğretim stratejileri [Effective teaching strategies for dyscalculia and learning difficulties in mathematics]*.

Saravanabhavan, S., & Saravanabhavan, R. (2001). Kültürler arası engelliliklere yönelik tutumlar [Cross-cultural attitudes toward disabilities]. *Educational Practice and Theory, 23*(2), 49-60.

Sezer, S., & Akın, A. (2011). 6–14 yaş arası eğitimde görülen matematik öğrenme bozukluğuna ilişkin öğretmen görüşleri [Teacher's views regarding mathematical learning disorder in education between ages 6–14]. *İlköğretim Çevrimiçi [Elementary Education Online]*. *10*(2), 757-775.

Shafira, F., Fitriani, A. D., & Darmayanti, M. (2023). İlkokul öğrencilerinin sayı okuryazarlığını geliştirmeye yönelik somut-resimli-soyut (CPA) bir öğretim modülünün geliştirilmesi [Developing a concrete-pictorial-abstract (CPA) instructional module to improve number literacy of elementary school students]. *EduHumaniora: Jurnal Pendidikan Dasar Kampus Cibiru, 15*(1). https://doi.org/10/eh.v15

Shalev, R. S., & Von Aster, M. (2008). *Gelişimsel diskalkulinin tanımlanması, sınıflandırılması ve yaygınlığı [Definition, classification, and prevalence of developmental dyscalculia]*. *Encyclopedia of Language and Literacy Development.*

Shalev, R. S., Manor, O., & Gross-Tsur, V. (2005). Developmental dyscalculia: a prospective six-year follow-up. *Developmental Medicine and Child Neurology, 47*(2), 121–125. https://doi.org/10.1017/s0012162205000216

Smith, J. A., Flowers, P., & Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, method and research.* Sage.

Wadlington, E. M., & Wadlington, P. M. (2006). *Disleksi ve diskalkulinin eğitimcileri ve öğrencilerini nasıl etkilediği [How dyslexia and dyscalculia affect educators and students]*. Paper presented at the Annual Conference of the International Association of Children Education, San Antonio, TX.

Yıldırım, A., & Şimşek, H. (2011). *Sosyal bilimlerde nitel araştırma yöntemleri [Qualitative research methods in the social sciences]*. Seçkin Yayıncılık.