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WE ASKED TEACHERS: DO YOU KNOW WHAT DYSCALCULIA IS?

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Abstract

This study aims to determine the knowledge levels of primary school, mathematics, special education, and Psychological Counseling & Guidance (PCG) teachers on Dyscalculia. A descriptive survey model was used for the research. Four hundred eighty-nine teachers were selected for the study, including 254 primary school teachers, 130 high school math teachers, 53 psychologists, 28 special educators, and 24 secondary school math teachers. A survey form devised by Dias, Pereira, and Van Borsel (2013) during the research, including 18 questions, 2 of which were open-ended and 16 closed-ended, was used. The obtained data reveal that most participating teachers do not have adequate knowledge and experience on the meaning, effects, root causes of dyscalculia, and intervention strategies for dyscalculic children.

Keywords: Dyscalculia, math learning difficulties, dyscalculia awareness.

INTRODUCTION

Dyscalculia, having an incidence of approximately 3-6.5 % range (Butterworth, 2005), is defined as a specific learning disability characterized by the inability to learn basic arithmetic facts, process numerical quantities, and do accurate and fluent calculations. The difficulties faced should be below expected for the individual's chronological age and not result from inadequate education, daily activities, or mental disabilities (American Psychiatric Association, 2013). In the ICD-10, Classification of Mental and Behavioral Disorders, the World Health Organization (WHO) describes dyscalculia as involving a specific impairment in arithmetical skills that is not solely explicable based on general mental retardation inadequate schooling (ICD-10, Version: 2019, Article: F81.2). It is stated that deficiency present in dyscalculic individuals is inadequate in basic computational skills such as addition, subtraction, multiplication, and division, rather than the more abstract mathematical skills involved in algebra, trigonometry, and geometry or calculus (WHO, 2010).

Although there is no consensus reached on the cause of dyscalculia, the most common three views in the relevant literature can be listed as follows: The first view argues that dyscalculia occurs because of dysfunction in the mathematics-related neural areas of the brain (Agostini, Zoccolotti, & Casagrande, 2022), while the second asserts that dyscalculia is mainly an outcome of working memory deficiency (Keeler & Swanson, 2001). However, some researchers, such as Gifford (2005, 2006), denied the

existence of dyscalculia, interpreting it as a low mathematical performance displayed by some individuals due to behavioural, emotional, and/or experiential reasons.

Since dyscalculic students have different cognitive profiles, the incidence and level of behavioural characteristics may considerably vary (Gifford & Rockliffe, 2012). Reasons for this difference may include environmental factors, cultural factors (e.g., duration of education, characteristics of the counting system used, etc.), prenatal and postnatal illnesses, or socio-emotional difficulties (e.g., math anxiety) (Kaufmann et al., 2013). Yet, major common features and the relationship with mathematical performance can be given, and individual differences arise from the stated situations.

Dyscalculia can be expressed as a state of disability to sense numbers. Starting from this point, dyscalculic individuals can have difficulties understanding the meaning of numbers, counting, understanding numerical relations, and learning the four operations with numbers (Sharma, 2015). For example, they have difficulty determining how significant their answers are in an estimation, counting backward, and discerning the greater one of two numbers. They find the four operation signs (+, -, x, and /) confusing.

It is denoted that visuo-spatial memory deficiencies are widely present among students with dyscalculia (Alloway, 2011; Mammarella, Caviola, Giofrè, & Szűcs 2018). Visuo-spatial memory plays a relatively substantial role in mental operations, tracking mathematical operations, visualizing the appropriate mathematical model for a problem. Geometric thinking is based on spatial reasoning, and the improvement of spatial abilities is of great importance for learning geometry (Galitskaya & Drigas, 2021). Individuals suffering from visuo-spatial memory deficiencies can have difficulties in finding directions (left-right, east-west), reading maps, tables, analog clocks, and sequencing.

Dyscalculic individuals are relatively slow in comparison with their peers in doing mathematical operations. Dyscalculic individuals' brains need more time to do calculations (Butterworth, 2005). Dyscalculic individuals, in general, have a poor perception of elapsed time (Tobia, Rinaldive, & Marzocchi, 2018) and therefore may have difficulty in the effective use of time in exams. It is also stated that challenges encountered in the conception of time can be an essential indicator of learning disability.

Though taught different counting and calculation strategies, dyscalculic children insist on finger counting despite their advancing age (Mutlu & Soylu, 2018; Mutlu, Akgün, & Akkuşçi, 2020). One of the most important reasons for dyscalculic individuals to insist on finger counting strategies is ascribed to the fact that the fingers reduce the workload of working memory, and this has positive effects on their mathematical performance (Crollen et al., 2011). Indeed, dyscalculic children are denoted to stay one year behind their peers in terms of working memory capacity (Geary, Hoard, Byrd-Craven, and DeSoto, 2004).

Psychological problems can often accompany dyscalculia, and that can boost negative academic results. Dyscalculic children may develop low self-efficacy, lack of motivation, a feeling of guilt, math anxiety, and even school phobia (Ashcraft and Ridley, 2005; Ramirez et al., 2018). Dyscalculic individuals generally have high levels of math anxiety (Carey, Hill, Devine, & Szucs, 2015; Mutlu, 2019). Their high level of math anxiety can have an adverse and destructive effect on math achievement by triggering working memory deficiency (Ashcraft & Kirk, 2001; Mutlu, 2017).

In reviewing studies on dyscalculic children, it was found that children can learn mathematics, although not at the same pace as their peers, if the learning environment is appropriately adapted, considering their disability (Mutlu & Akgün 2016). Concrete-semi-concrete-abstract sequential strategy combined with direct teaching method, technology-assisted mathematics teaching, and game-based teaching methods can be preferred for teaching mathematics to children with dyscalculia (Swanson & Hoskyn, 1998; De Castro, Bissaco, Panccioni, Rodrigues, & Domingues, 2014; Mutlu & Akgün, 2019; Mutlu & Olkun, 2019; Benavides-Varel et al. 2020; Milton, Flores, Moore, Taylor, & Burton, 2019).

Although dyscalculia is not a consequence of inappropriate pedagogical methods, appropriate knowledge and educational practices for those students are essential for a successful intervention. Primary school teachers have a substantial part in the early detection of dyscalculia-related disabilities and in ensuring the right and adequate intervention. Therefore, teachers need to be aware of the characteristics of dyscalculia and dyscalculic students, primarily in terms of identifying these children at an early age, fulfilling and developing a successful educational intervention (Chideridou–Mandari, Padeliadu, Karamatsouki, Sandravelis, & Karagiannidis, 2016; Sousa, Dias, & Cadime, 2017). In this regard, when the relevant literature is reviewed, there appear to be many studies in the world and Turkey, through which the teachers' opinions on what characteristics dyscalculia and students with dyscalculia have been investigated.

A study in Brazil by Dias, Pereira, and Van Borsel (2013), determined 45% of 63 primary school teachers to deprive of knowledge of what dyscalculia was, and only 12.9% of teachers could describe the symptoms of dyscalculia. Several studies in India (Saravanabhavan & Saravanabhavan, 2010; Kamala and Ramganesh, 2013; Shukla and Agrawal, 2015) reported that teachers and pre-service teachers have limited knowledge of learning disabilities in general. In the study in Greece by Chideridou, Mandari et al., 114 high school maths teachers were revealed to know dyscalculia in general, but underperform, when it came to the characteristics of dyscalculic students, and some teachers confuse dyscalculia with intellectual disability. In a survey in Malaysia on the awareness of 80 primary school teachers on dyscalculia (Fu & Chin, 2017), approximately 58% of the teachers were unfamiliar with dyscalculia. In a study in Nepal (Adhikari, 2014), primary school teachers were reported to have limited knowledge about the characteristics of dyscalculia and felt unconfident to deal with dyscalculia. However, they had some experiences with dyscalculic children. Likewise, a study in Portugal by Sousa, Dias, and Cadime (2017) with 175 primary school teachers stated a large percentage of teachers (75.4%) have heard of dyscalculia before. Still, very few of them have worked with a dyscalculic student.

Many studies on the awareness and knowledge levels of teachers and pre-service teachers on dyscalculia were conducted in Turkey as well (Sezer & Akın, 2011; Karadeniz, 2013; Karasakal, 2019; Kuruyer, Çakıroğlu, & Özsoy, 2019; Nurkan & Yazıcı, 2020). In the studies conducted, math teachers were determined not to know the concept of dyscalculia enough (Sezer & Akın, 2011; Karadeniz, 2013; Nurkan & Yazıcı, 2020); similarly, most of the classroom teachers were identified to be unaware of the dyscalculia phenomenon and lack the knowledge required to cope effectively with dyscalculic children. Again, primary school pre-service teachers are reported to have an awareness of mathematical learning difficulties, but lack knowledge about math disabilities, have misconceptions about dyscalculia, not have foresight about how to discern mathematical learning difficulties and how to solve them (Kuruyer, Çakıroğlu, & Özsoy, 2019).

Studies in the world and Turkey to determine teachers' awareness and knowledge levels on dyscalculia and characteristics of dyscalculic students point out that teachers mostly do not know about dyscalculia and the attributes of dyscalculic students enough. However, it can be stated that the number of participating teachers in the studies is relatively low, and thus, the branch diversity is not sufficiently included. The present study examines the awareness of special education, primary school, secondary school, high school math, and psychological counselling and guidance teachers on dyscalculia and the dyscalculic student characteristics.

METHOD

Research Model

A descriptive survey model was used in the research. Descriptive surveys are the research approaches aiming to describe a previous or present situation as it currently is. The individual or object, which is the subject of the research, is tried to be described in its conditions and as it is. No effort is made to change or influence the variables in any way (Karasar, 2016). A survey technique was used in the research to reveal the knowledge and awareness of teachers on dyscalculia. A survey is a systematic question form prepared to collect information from primary sources. The purpose of using this

technique is to systematically collect and store the information, which will solve the problem of the research and test the hypotheses dealt with (İslamoğlu & Alnıaçık, 2019). There are also 2 open-ended questions about the definition of dyscalculia and intervention for the dyscalculic student in the questionnaire. For the analysis of these questions, the content analysis method used in qualitative research was used.

Population and Sample

The research population was composed of teachers working in primary, secondary, and high school level state schools and private education institutions in a city located in Turkey, affiliated with the Ministry of National Education in 2019. The research sample included 489 teachers who volunteered to participate in the research. They were distributed among 254 elementary school teachers, 130 high school mathematics teachers, 53 psychological counselling and guidance teachers, 28 special education teachers, and 24 secondary school mathematics teachers. The purposive sampling method, one of the non-random sampling methods, was used to determine the sample. This sampling method is intended to ensure the greatest possible diversity by including Primary, secondary, high school, special education, and PCG (psychological counselling and guidance) teachers who teach mathematics or are likely to encounter dyscalculic children in their professional lives. Table 1 outlines the demographic characteristics and distributions of the attendees.

Table 1. Frequency and percentage distributions on demographic characteristics of attendees

Variables		N	%
Gender	Male	205	41.9
	Female	284	58.1
Seniority (professional seniority)	Less than one year	46	9.4
	2-5 years	227	46.4
	5-10 years	153	31.3
	Ten years and above	63	12.9
Branch	Special Education	28	5.7
	Math (High School)	130	26.6
	Math (Secondary School)	24	4.9
	PCG	53	10.8
	Primary School Teacher	254	52
Educational Background	College	14	2.9
	Undergraduate	446	91.2
	Master's Degree	29	5.9
Age	0-30	303	62
	30-35	130	26.5
	35-40	44	9
	40-45	12	2.5

When looking at Table 1, it is seen that 58.1% of the participating teachers in the research are female, and 41.9% are male. Regarding the seniority variable, the rate of those who served less than a year is 9.4%; between 2-5 years, 46.4%; between 5-10 years, 31.3%; 10 years or more is 12.9%. When the educational status is examined, most of the attendees (91.2%) are seen to have an undergraduate degree.

Data Collection Tool

Data from the attendees were collected through a survey. The survey form used in the study was designed by Dias, Pereira, and Borsel (2013), based on the literature and experiences related to dyscalculia. It was adapted into Turkish by the researchers. During the adapting process of the survey, first, the survey form was translated into Turkish by the researcher following the Turkish culture and education system. Subsequently, two specialist lecturers in English teaching were asked to assess how well the translated items of the questionnaire corresponded to the original. Upon the experts' recommendations, relevant changes were made to the translated items. Eventually, the survey was made ready to be applied by having the language compliance and comprehensibility of the question items translated into Turkish, and checked by an expert working in the Turkish Language Education field. To evaluate the awareness and knowledge of the teachers on dyscalculia, the survey form includes 18 questions, apart from the ones aiming to determine demographic characteristics. Two of these questions are open-ended, and 16 are closed-ended. Knowledge areas desired to be measured in the survey and the ordinal numbers of the relevant items are presented in Table 2.

Table 2. Measured knowledge areas of the survey items

Knowledge Areas	Relevant Items
Meaning and concept of dyscalculia	1,2,3,4,8,13
Causes of dyscalculia	18
Characteristics of dyscalculia	5,7,9,10,11,12,15
Effects of dyscalculia	14,16
Intervention strategies for dyscalculia	6, 17

As shown in Table 2, the question items in the survey were handled under five categories. These categories are related to the concept and meaning, the causes, characteristics, effects of dyscalculia, and intervention strategies for dyscalculia.

Data Analysis

In analysing the closed-ended items of the survey form applied within the research, descriptive statistics were produced using the SPSS 23 software. Two open-ended questions were analysed using content analysis.

Limitations

The research is limited to the general survey model in terms of method. The data obtained in the current study are limited to the teachers' responses awareness and knowledge of the teachers on the dyscalculia survey. Therefore, the study is not extensive enough to explain why and how teachers gave these responses. Examination of such issues is worth considering in future research. The study's sample does not have the capacity to represent a larger national population. Moreover, the scope of the research was limited to teachers in public schools, private schools were not included in the research.

RESULTS

This study aimed to examine the dyscalculia awareness of teachers working in the central district of a city in Turkey. For this purpose, special education, primary, secondary, high school, and PCG

(psychological counselling and guidance) teachers have applied the survey and posed 18 questions. The findings obtained from the answers to those questions were depicted in tables.
First, the question "Do you know what dyscalculia is?" was addressed to the teachers. Findings relevant to this question are presented in Table 3.

Table 3. For the question, "Do you know what dyscalculia is?", Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	22	78.6	6	21.4	28
Primary School Teacher	162	64.3	90	35.7	252
Math (Secondary School)	14	58.3	10	41.7	24
Math (High School)	84	65.6	44	34.4	128
PCG	51	96.2	2	3.8	53
Total	**333**	**68.7**	**152**	**31.3**	**485**

When Table 3 is examined, a total of 485 answers have been received from different branches for this question. While 333 (68.7%) of the teachers answered yes, 152 (31.3%) answered no. It has been the PCG teachers who answered “yes” the most (96.2%). It is noteworthy that secondary school math teachers have been the ones who answered “no” the most (41.7%). According to statements of whether knowing what dyscalculia is, the ranking from highest to lowest has turned out to be as follows: PCG (96.2%), special education (78.6%), high school math (65.6%), primary school (64.3%), and secondary school math (58.3%).

As the second question of the survey, teachers, having stated to know what dyscalculia is, were requested to describe dyscalculia. Content analysis of the answers given is complete and presented in Table 4.

Table 4. Description of dyscalculia by teachers

Themes	Codes	*f*	*Examples from Answers*
Specific learning disability	Mathematical learning disability	239	*"It is a kind of mathematical learning disability. It is a problem related to numbers."* (T, 44). *“Despite not having an intelligence problem, it is the difficulty that the student has in learning mathematics.”* (T, 48).
Incomprehension of mathematical language	Incomprehension of numbers and symbols	17	“*It is the disability of comprehending numbers and symbols in mathematics.”* (T, 273). *“The disability, limiting an individual's mathematical skills and causing difficulties with operations and numbers.”* (T, 145) *“It is the condition of inability to learn mathematical symbols and operations, despite not having a learning disability.”* (T, 449).
	Difficulty in associating mathematical operations	4	*“It is the condition of having difficulty in associating numbers, symbols, mathematical operations, though the individual does not have a mental problem.”* (T, 132). *“Inability to establish relationships between concepts, and comprehend them.”* (T, 149).

Table 4. (Continued). Description of dyscalculia by teachers

Themes	Codes	*f*	*Examples from Answers*
Association with dyslexia	Mirror writing of the words/sounds/digits	9	*"Mirror writing, by a student, of words and numbers"* (T, 224). *"Mirror writing of the sounds which make up the words"* (T, 4). *"Inability to read and write letters like b and d*" (T, 215). *"Mirror writing of digits"* (T, 435).
	Mathematical equivalent of dyslexia	3	*"Dyslexic state in mathematics. Learning disability in mathematics"* (T, 17). *"Dyscalculia is the inability to do mathematical calculations. It is a part of dyslexia."* (T, 151).
Academic failure	Failure in math	7	*"Failure of the student in math"* (T, 332).
Neurological disorder	Mental disability	2	*"It is a mental problem and math learning disability"* (T, 160). *"It is a mental deficiency"* (T, 85).

As seen in Table 4, a total of 281 teachers tried to define dyscalculia. On the other hand, 208 teachers did not answer this question. When the responses were scrutinized, it was seen that teachers mostly tried to describe dyscalculia as a mathematical learning disability, which is a specific learning disability (239). The number of teachers defining dyscalculia as the incomprehension of mathematical language was 21. Additionally, 12 teachers tried to describe dyscalculia by associating it with dyslexia, and seven attempted by associating it with academic failure in the math course. On the other hand, two teachers associated dyscalculia with a neurological disorder and mental retardation.

As the third question, the teachers were asked the question, "Have you ever discussed the concept of dyscalculia during your occupational training? (Within the undergraduate/postgraduate period)". The findings of the responses to this question are given in Table 5.

Table 5. For the question, "Have you ever discussed the dyscalculia concept during your occupational training?", Frequency and percentage distributions on the responses from the teachers

Branch	License (Undergraduate)				Postgraduate			
	Yes		No		Yes		No	
	N	%	N	%	N	%	N	%
Special Education	8	28.6	20	71.4	0	0	13	100
School Teaching	68	27.4	179	72.2	15	11.8	112	88.2
Math (Secondary School)	6	25	18	75	1	8.3	11	91.7
Math (High School)	35	28	89	72	4	6.9	53	91.4
PCG	41	77.4	12	22.6	4	40	6	60
Total	**158**	**33.1**	**318**	**66.5**	**24**	**10.9**	**195**	**88.6**

According to Table 5, the number of teachers confirming to have ever discussed "dyscalculia" during their undergraduate education is 158 (33.1%), while those saying "no" are 318 (66.5%). When the distribution of those saying "yes" is examined in terms of the branch, it is seen that the highest rate belongs to PCG teachers (n=41, 77.4%). The rate of "yes" answers, except for this branch, ranged from 25% to 28%. Accordingly, if PCG teachers are exempted, only one out of four teachers ever discussed the dyscalculia concept during the undergraduate education period. When looking at the

postgraduate period, those rates can be said to be much lower. The number of those who said "yes" was 24 (10.9%), while those who said "no" were 195 (88.6%). If Table 5 is analysed based on branches, PCG teachers are seen as the group, which discussed the dyscalculia concept the most during this period (n=4, 40%). However, when looking at other branches, it was revealed that only one out of every ten teachers had such a discussion during the graduate school period.

As the fourth question, a similar question was asked to the teachers about dyslexia (reading difficulty), which is one of the specific learning difficulties. The results of the teacher responses to the question "Have you ever discussed dyslexia during your vocational education? (undergraduate/graduate period)" are provided in Table 6.

Table 6. For the question, "Have you ever discussed the dyslexia concept during your occupational training?", Frequency and percentage distributions on the responses from the teachers

Branch	Undergraduate				Postgraduate			
	Yes		No		Yes		No	
	N	%	N	%	N	%	N	%
Special Education	24	88.9	3	11.1	6	75	2	25
School Teaching	190	75.7	61	24.3	29	34.5	54	64.3
Math (Secondary School)	7	35	13	65	4	36.4	7	63.6
Math (High School)	72	56.7	55	43.3	9	23.7	29	76.3
PCG	46	86.8	7	13,2	3	37.5	5	62.5
Total	**339**	**70.9**	**139**	**19.1**	**51**	**34.4**	**97**	**65.6**

According to Table 6, the teachers can be said to be more familiar with the dyslexia concept. When looking at the answers, 339 (70.9%) teachers answered "yes" to this question, while 139 (19.1%) answered no. When analysing on a branch basis, it is seen that special education teachers marked the "yes" option at the highest rate (N=24, 88%). Based on other branches, the ranking of the "yes" option from high to low occurred as; PCG 46 (86%), primary school 190 (75.7%), high school math 72 (56.7%), and secondary school math teachers 7 (35%). In the postgraduate period, this time, it was seen that this concept was less discussed. The number of those who said "yes" was 51 (%34), while those who said "no" were 97 (%65.6). A similar ranking to the undergraduate period was revealed, although the rates have decreased from a branch-based perspective. Eventually, compared to dyscalculia, it is possible to say that dyslexia is a learning disability with which the attendees are more familiar.

As the fifth question, "Have you ever happened to face situations in your professional career that caused you to doubt dyscalculia?" was addressed to the teachers. Findings relevant to this question are presented in Table 7.

Table 7. For the question, "Have you ever happened to face situations in your professional career that caused you to doubt dyscalculia?", Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	5	17.9	23	82.1	28
School Teaching	69	27.9	178	72.1	247
Math (Secondary School)	9	37.5	15	62.5	24
Math (High School)	33	25.8	95	74.2	128
PCG	9	17.3	43	82.7	52
Total	**125**	**26**	**354**	**74**	**479**

When Table 7 is examined, the total number of responses to this question is seen to be 479. While 125 (26%) of these answers were yes, 354 (74%) were no. Of those who stated that their students might have dyscalculia in their professional life, the highest rate, 37.5%, is found among secondary school

mathematics teachers. This rate was 27.9% for primary school teachers, 25.8% for high school math teachers, 17.9% for special education teachers, and 17.3% for PCG teachers. Although secondary school mathematics teachers answered the first question of this study, which was "Do you know what dyscalculia is?", with the least number of "yes," the fact that, in the fifth question, those teachers were the ones who expressed the doubt of dyscalculia with the highest rate may be indicating that the symptoms of dyscalculia were not known enough.

The sixth question of the questionnaire was related to the fifth question, and the teachers, who stated to have ever had a student whom they suspected of being dyscalculic before, were asked how they intervened with these students. Only 89 teachers answered this question, and requested to answer as open-ended.

The answers given are summarized in Table 8.

Table 8. Interventions to Students, Assessed to Have Dyscalculia

Themes	Codes	*f*	Examples from Answers
Referral	Referral to the Guidance and Research Center (GRC)	28	*"I referred the student to the GRC"* (T, 205). *"Through communications with primary school teachers, I fulfilled coordinations to ensure the student be referred. I referred the student to the hospital and GRC."* (T, 168).
	Referring to the school's guidance service	20	*"I referred the student to the PCG (psychological counseling and guidance) teacher in our school"* (T, 256). *"I referred the student to the counseling service"* (T, 46).
Educational Intervention	Material-Assisted Concrete Teaching	13	*"I used concrete teaching materials"* (T, 299). *"I concretized the mathematical concepts"* (T, 474).
	Using different teaching methods in the class	11	*"I tried different methods such as games, visuals, etc."* (T, 173-T, 190). *"I tried different teaching methods and techniques, like teaching methods with games"* (T, 9).
	Conducting a private study with the individual	10	*"I taught one-on-one."* (T, 275). *For the person I suspected, I strived to ensure a different environment to study. I reduced the lessons to easier and simpler subjects"* (T, 151).
	Simplifying the lesson	5	*"I conducted practices in the educational environment. I simplified the teaching"* (T, 162). *"I simplified the lesson and supported it with materials"* (T, 13).
Gathering Information	Doing research	2	*"I probed into the situation and strived to find a solution"* (T, 226).

As shown in Table 8, the intervention ways for students suspected by teachers of being dyscalculic have been addressed under three categories: referring, educational intervention, and information

gathering. In response to the question, teachers' interventions mainly referred them to guidance and research centres (28). While a referral is a stage of the diagnostic process, it is not the first step. The best step for teachers is to first meet with the school's guidance service and evaluate the situation by including the student's family in the process as well. In this regard, the number of teachers who referred the students to the school's guidance service was 20. In addition, some teachers also applied various educational interventions by providing concrete learning through the utilization of materials (13), delivering the lesson using different methods and techniques (11), studying privately with the individual (10), and simplifying the lesson. On the other hand, two teachers stated that they probed into children and dyscalculia before the first intervention since they did not know the situation.

As the seventh one, the question, "Can you discern a dyscalculic student in your class, if any?" was addressed to the teachers. The findings of the responses to this question are given in Table 9.

Table 9. For the question, "Can you discern a dyscalculic student in your class, if any?", Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Maybe		Total
	N	%	N	%	N	%	N
Special Education	13	48.1	7	25.9	7	25.9	27
School Teaching	68	27.3	68	27.3	113	45.4	249
Math (Secondary School)	3	12.5	8	33.3	13	54.2	24
Math (High School)	27	20.9	40	31	62	48.1	129
PCG	33	62.3	1	1.9	19	35.8	53
Total	**144**	**29.9**	**124**	**25.7**	**214**	**44.4**	**482**

As seen in Table 9, three different answering options were offered to the teachers for the 7th question, such as “yes,” “no,” and “maybe,” to enable them to mark the third option when they were not sure. Four hundred eighty-two responses were received. Of these answers, 144 (29.9%) were "yes," 124 (25.7%) were "no," and 214 (44.4%) were "maybe." If analysed based on a branch, the number of PCG teachers who declared the capability to understand whether a child has dyscalculia was 33 (62%). In comparison, the same number occurred as 13 (48.1%) for special education teachers, 68 (27.3%) for private school teachers, 27 (20.9%) for high school math teachers, and 3 (12.5%) for secondary school math teachers.

As the eighth, the question, "Is a dyscalculic student dyslexic at the same time?" was addressed to the teachers. Findings relevant to this question are given in Table 10.

Table 10. For the question, "Is a dyscalculic student dyslexic at the same time?", Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	4	4.8	23	85.2	27
School Teaching	6	2.6	229	97.4	235
Math (Secondary School)	0	0	20	100	20
Math (High School)	9	7.8	107	92.2	116
PCG	1	2	50	98	51
Total	**20**	**4.5**	**429**	**95.5**	**449**

According to Table 10, 449 answers were received for this question, of which 20 (4.5%) were "yes," while 429 (95.5%) were "no." Therefore, the vast majority of teachers can be said to have reached a consensus that a dyscalculic student is not necessarily dyslexic.

As the ninth, the question, "A child has difficulty understanding the measures (weight, distance, time). Might that child have dyscalculia?" was addressed to the teachers. Findings obtained from the teachers' responses are presented in Table 11.

Table 11. For the question, "A child has difficulty reading the measures (weight, distance, time). Might that child have dyscalculia?" Frequency and percentage distributions on the responses from the teachers

Type of Teaching	Yes		No		Total
	N	%	N	%	N
Special Education	17	65.4	9	34.6	26
School Teaching	128	54.7	106	45.3	234
Math (Secondary School)	15	65.2	8	34.8	23
Math (High School)	77	63.6	44	36.4	121
PCG	40	80	10	20	50
Total	**277**	**61**	**177**	**39**	**454**

According to Table 11, 454 answers were received for this question. 277 (61%) of those answers were "yes," while 177 (39%) were "no." In this regard, difficulty in sensing the measure, one of the symptoms of dyscalculia, was not seen as a symptom of dyscalculia by a considerable rate, 39% of the teachers. When Table 11 is analysed according to the branch variable, PCG teachers can think more homogeneously while answering the question compared with the teachers of other branches. The least number of "yes" responses came from primary school teachers. The rates of other branches were close to each other. The branches, where "yes" answers were received, are sorted, from the highest rate to the lowest, as follows: PCG teachers 40 (80%), special education teachers 17 (65.4%), secondary school mathematics teachers 15 (65.2%), high school mathematics teachers 77 (63.6%), primary school teachers 128 (54.7%).

As the tenth question, "When a student, having no problems in his previous education life before, meets mathematics, then suddenly starts to underperform. Might this be a suggestive symptom of dyscalculia?" was addressed to the teachers. The findings of the responses to this question are included in Table 12.

Table 12. For the question, "When a student, having no problems in his previous education life, meets mathematics, he suddenly starts to perform very poorly. Might this be a suggestive symptom of dyscalculia?" Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	18	69.2	8	30.8	26
School Teaching	149	62.8	88	27.2	237
Math (Secondary School)	15	65.2	8	34.8	23
Math (High School)	85	70.8	35	29.2	120
PCG	34	69.4	15	30.6	49
Total	**301**	**66.1**	**154**	**23.9**	**455**

Dyscalculic students can perform successfully in other courses. Although dyscalculic students often have dyslexia symptoms, it can also be considered a failure in mathematics. When Table 12 is examined, it is seen that 455 responses to this question were received. While 301 (66.1%) of these answers were yes, 154 (23.9%) were no. When examined based on branch, it can be said that the yes/no rates were close to each other. It is seen that the highest rate of "yes" answers among the branches belonged to high school math teachers at 70%, while the lowest rate belonged to primary school teachers (62.8%).

As the eleventh question, "A student can solve math problems, in the form of 5+3=8, given by his teacher. But when the student is asked the same problem as '*Ayşe has five candles, and Fatma has three. How many candles do they both have in total*?' in verbal form, the student cannot solve the problem this time. Might that child have dyscalculia?" was addressed to the teachers. The findings obtained from the responses are presented in Table 13.

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Table 13. Frequency and percentage distributions of the answers for the given scenario

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	15	57.7	11	23.3	26
School Teaching	90	38.5	144	61.5	234
Math (Secondary School)	11	52.4	10	47.6	21
Math (High School)	50	42.4	68	57.6	118
PCG	16	32.7	33	67.3	49
Total	**182**	**40.6**	**266**	**59.4**	**448**

Dyscalculic children have difficulty in solving verbal problems. When the problem is verbally expressed, it may indicate that the child does not understand the operation if the child cannot solve it. Therefore, teachers are expected to answer this question with “yes.” However, when Table 13 is examined, it is seen that 448 responses were received, of which 182 (40.6%) were "yes" and 266 (59.4%) were "no." When analysed on a branch basis, it is seen that special education teachers gave the highest proportion of "yes" answers with 57.7%. Secondary school maths teachers answered with “yes” at a rate of 52.4%, high school math teachers 42.4%, primary school teachers 38.5%, and PCG teachers 32.7%.

As the twelfth question, "A child has difficulty in using concepts such as bigger/smaller or less/more when comparing objects per their size and quantity. Might that child have dyscalculia?" was addressed to the teachers. The findings obtained from the responses are presented in Table 14.

Table 14. For the question, "A child has difficulty using concepts such as bigger/smaller or less/more when comparing objects per their size and quantity. Might that child have dyscalculia?" Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	18	69.2	8	30.8	26
School Teaching	143	60.9	91	39.1	234
Math (Secondary School)	18	81.8	4	18.2	22
Math (High School)	81	67.5	38	33.5	119
PCG	43	86	7	14	50
Total	**303**	**68.3**	**140**	**31.7**	**443**

Dyscalculic children have difficulty using bigger/smaller or less/more concepts when comparing objects in terms of their size and quantity. Therefore, teachers were expected to answer this question with “yes.” When Table 14 is examined, it is seen that 443 answers were received, of which 303 (68.3%) were "yes" while 140 (31.7%) were "no." When the rate of “yes” answers, based on branches, are examined from the highest to the lowest, it is seen that 86% of PCG teachers, 81.8% of secondary school math teachers, 69.2% of special education teachers, 67.5% of high school math teachers, 60.9% of primary school teachers answered “yes.” For the thirteenth question, the teachers were given options to determine which conditions were mainly confused with dyscalculia. As shown in Figure 1, the responses are presented as a bar graph.

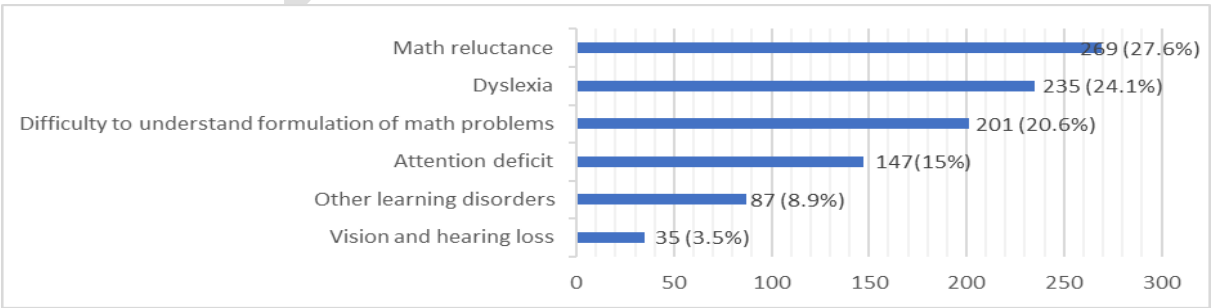

Figure 1. Conditions confused with dyscalculia

As shown in Figure 1, teachers stated reluctance towards mathematics to be the most confusing situation with dyscalculia (27%).

As the fourteenth question, “A child looks pretty anxious only in math lessons. Sometimes he feels disappointed and worried. He complains about the materials and clearly says/confirms that he doesn't like them. Might that child have dyscalculia?" was addressed to the teachers. The findings obtained from the responses are presented in Table 15.

Table 15. For the Question, “A child seems very anxious only in math lessons. Sometimes he feels disappointed and worried. He complains about the materials and clearly says/confirms that he doesn't like them. Might that child have dyscalculia?" Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	14	51.9	13	48.1	27
School Teaching	104	44.4	130	55.6	234
Math (Secondary School)	11	50	11	50	22
Math (High School)	59	49.2	61	50.8	120
PCG	25	50	25	50	100
Total	**213**	**47**	**240**	**53**	**453**

When Table 15 is examined, it is seen that 453 responses to this question were received. 213 (47%) of those responses were "yes" while 240 (53%) were "no." Dyscalculic children feel anxious during math lessons and have negative feelings toward math materials. However, considering most of the answers received from teachers, the situation given in this question was not seen as a symptom of dyscalculia by the teachers. In this regard, it can be argued that the teachers are not familiar enough with the symptoms of dyscalculia. When the answers are examined on a branch basis, 51% of special education teachers, 50% of secondary school math teachers and PCG teachers, 49.2% of high school math teachers, and 44.4% of primary school teachers gave the “yes” answer to this question.

As the fifteenth question, "A child has difficulties in sorting (dates, counting numbers, ordinal numbers). Might that child have dyscalculia?" was addressed to the teachers. The findings obtained from the responses are presented in Table 16.

Table 16. For the question, "A child has difficulties in sorting (dates, counting numbers, ordinal numbers). Might that child have dyscalculia?" Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	22	81.5	5	18.5	27
School Teaching	156	66.7	78	33.3	234
Math (Secondary School)	16	72.7	6	27.3	22
Math (High School)	95	78.5	26	21.5	121
PCG	43	91.5	4	8.5	47
Total	**332**	**73.6**	**119**	**26.4**	**451**

According to Table 16, 451 responses were received for this question, of which 332 (73.6%) were "yes," and 119 (26.4%) were "no." Dyscalculic students have problems in counting numbers and sorting dates. In this regard, most of the teachers consider the scenario given in the question as a symptom of dyscalculia showing that they have some basic knowledge of dyscalculia. 91% of PDR teachers, 81.5% of special education teachers, 78.5% of high school math teachers, 72.7% of secondary school mathematics teachers, and 66.7% of primary school teachers answered “yes.”

As the sixteenth question, “Do you think dyscalculia can engender restlessness, anxiety, or behavioural changes?” was addressed to the teachers. The findings obtained from the responses are presented in Table 17.

Table 17. For the Question, "Do you think dyscalculia can engender restlessness, anxiety, or behavioural changes?", Frequency and percentage distributions on the responses from the teachers

Branch	Yes		No		Total
	N	%	N	%	N
Special Education	23	88.5	3	11.5	26
School Teaching	196	83.8	38	16.2	234
Math (Secondary School)	20	90.9	2	9.1	22
Math (High School)	111	91.7	10	8.3	121
PCG	49	100	0	0	49
Total	**399**	**88.3**	**53**	**11.7**	**452**

According to Table 17, 452 answers were received from the teachers for this question. 399 (88.3%) of those responses were "yes," and 53 (11.7%) were "no." Dyscalculia can cause restlessness, anxiety, behavioural changes, educational and professional failure in children. The teachers regarded this situation, given as a hint within the question itself, as a symptom of dyscalculia at a high rate of 88.3%. When responses were analysed on a branch basis, all PCG teachers were seen to have answered "yes." Additionally, 91.7% of high school math teachers, 90.9% of secondary school math teachers, 88.5% of special education teachers, and 83.8% of primary school teachers gave the "yes" answer to this question.

As the seventeenth question, "Which specialist do you think should intervene with a dyscalculic individual?" was asked to the teachers, enabling them to give multiple answers. Figure 2 shows the bar graph of the responses received.

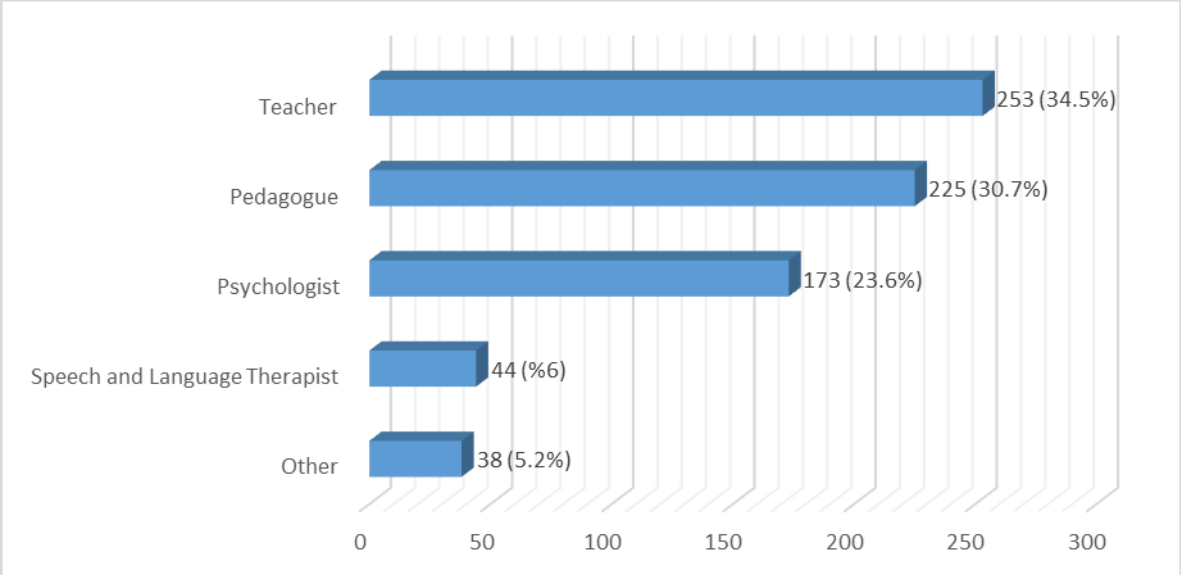

Figure 2. From teachers' perspective, the specialists that are supposed to intervene in a dyscalculic individual

When Figure 2 is examined, 34% of the attendees stated that they had thought teachers were the specialists, who should intervene with a dyscalculic individual. The rate of those stating that pedagogues should intervene was 30.7%, while 23.6% opted for psychologists, 6% for speech and language therapists, and 5.5% for the "other" option.

As the survey's final question, "What do you think the cause of dyscalculia is?" was asked to the teachers, again enabling them to give multiple answers. Figure 3 shows the bar graph of the responses received.

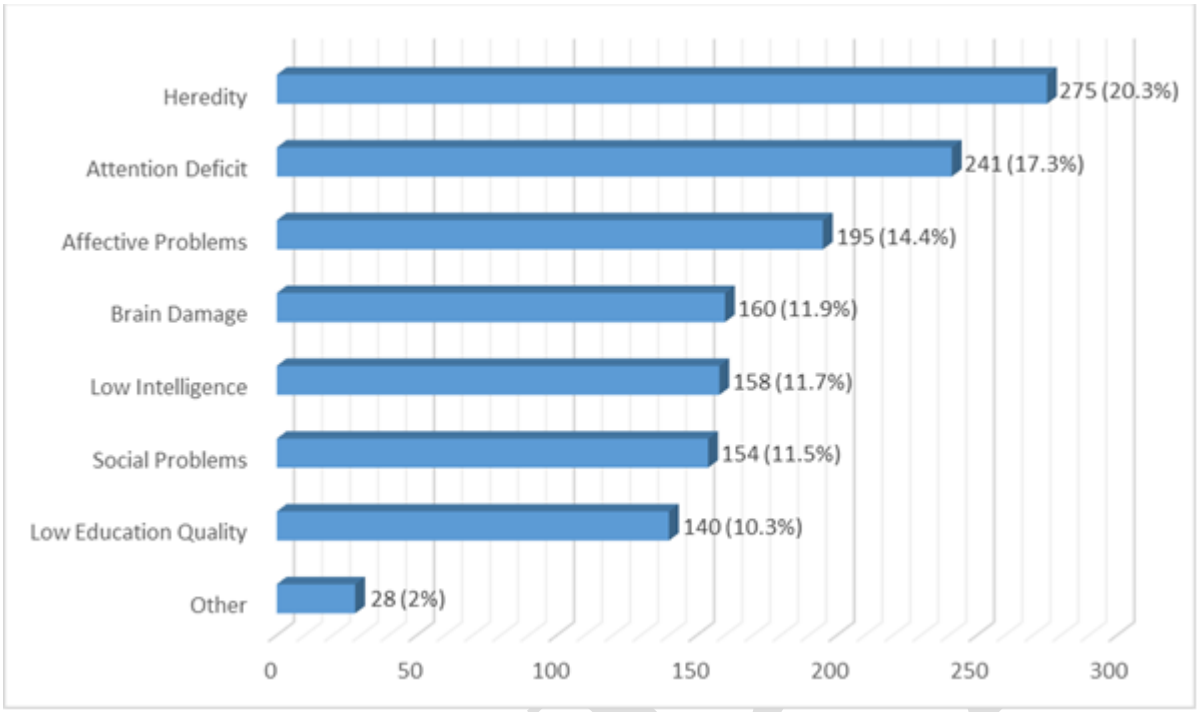

Figure 3. Causes of dyscalculia from teachers' perspective

20.3% of teachers ascribed the possible causes of dyscalculia to heredity, 17.9% to attention deficit, 14.4% to affective problems, 11.7% to low intelligence, 11.5% to social issues, and 10.3% to inadequate education quality.

DISCUSSION, CONCLUSION, and RECOMMENDATIONS

Dyscalculia similar to dyslexia, dysgraphia, and dyspraxia, is one of the learning difficulties students may encounter but is not known enough by teachers and parents (Henderson, 2013). Teachers need to be familiar with dyscalculia to develop strategies and methods to meet the needs of dyscalculic students, and inform society and parents on various aspects of dyscalculia accurately and adequately. This study aimed to determine teachers' knowledge level via an 18-item survey on five knowledge areas, consisting of the meaning, characteristics, effects, causes of dyscalculia, and intervention strategies for dyscalculia children. Within the scope of the study, 489 teachers consisting of special education, primary school, secondary and high school math, and psychological counselling and guidance (PCG) teachers were reached.

During the study concerning the dyscalculia knowledge area, the question "Do you know what dyscalculia is?" was asked to teachers, and approximately 69 of them answered "yes." According to statements of whether knowing what dyscalculia is, the ranking from highest to lowest has turned out to be as follows: PCG, special education, high school math, primary school, and secondary school math. As expected in the study, it was determined that the knowledge level of special education and PCG teachers about dyscalculia was higher than that of other teachers. Indeed, special education and PCG teachers may have seen the subjects related to learning difficulties and intervention to learning difficulties at the undergraduate level relatively more than other teachers. However, when it comes to the definition of dyscalculia, it is seen that the rate of teachers who managed to define dyscalculia correctly dropped to around 50%. When the definitions were scrutinized, most of the teachers were determined to have been deprived of adequate knowledge, made incomplete and inaccurate definitions, and confused dyslexia with dyscalculia. Many national and international studies confirm that teachers are not familiar enough with dyscalculia (Butterworth, Varma, & Laurillard, 2011; Tennant & Tennant, 2010; Sezer & Akın, 2011; Karadeniz, 2013; Karasakal, 2019; Kuruyer,

Çakıroğlu, & Özsoy, 2019; Nurkan & Yazıcı, 2020) For example, in a study conducted by Fu and Chin (2017) in Malaysia, it was determined that approximately 58% of 80 primary school teachers did not know about dyscalculia. Again, in a case study conducted by Nurkan and Yazıcı (2020) in Turkey, it is reported that math teachers do not have full knowledge of dyscalculia.

In general, two hypotheses on the causes of dyscalculia are more prominent. The first one can be worded as a dysfunction in the mathematics-related neural area of the brain, while the second can be briefly expressed as a working memory deficiency (Luculano, 2016). In this regard, within the second knowledge area of the research, it was tried to determine the knowledge levels of the teachers on the causes of dyscalculia. Conditions such as affective characteristics, low intelligence, social problems, and low education quality, which are not among the causes of dyscalculia (American Psychiatric Association, 2013, WHO, 2013), was regarded among the causes of dyscalculia by most of teachers. This implies that teachers do not have adequate knowledge about the causes of dyscalculia.

The data obtained in the knowledge areas of dyscalculic student characteristics and consequences of dyscalculia show that many teachers have limited knowledge. Indeed, this is expressed in a study by Chideridou–Mandari et al. (2016). Moreover, it is considered that most teachers interpret the characteristics of dyscalculic children over those of underachieving math students. Thus, it can be concluded that it is a foreseeable situation for teachers, which cannot define dyscalculia correctly and adequately, to lack sufficient knowledge about dyscalculic children's features.

The teachers were then asked how they intervened with their students suspected to be dyscalculic to determine their level of knowledge on the intervention for dyscalculic children. Only 18% of the participating teachers answered this question. That the teachers are not familiar enough with the subject can be argued as one of the reasons for this question to be answered by the least number. In a similar study conducted with 100 primary school teachers, it was determined that most of the teachers were not familiar enough with the strategies they should use to support their dyscalculic students (Tennant & Tennant, 2010). Again, in a study conducted in Turkey, it was reported that most primary school math teachers lacked the knowledge to effectively cope with the problems of dyscalculic children (Karasakal, 2019).

In conclusion, based on the data obtained in the study, most of the participating teachers do not have sufficient knowledge and experience regarding the meaning, characteristics, consequences, causes of dyscalculia, and intervention strategies for dyscalculic children. Although the incidence of dyscalculia is around 6.5%, consistent with that of dyslexia (Gross-Tsur, Manor, & Shalev, 1996), unfortunately, dyscalculia is not as widely known as dyslexia among teachers. Teachers, who are not familiar enough with dyscalculia and do not know how to intervene in children with dyscalculia, may end up with depriving children with dyscalculia as a qualified educational intervention needed much. Moreover, children's deprivation of the mathematical knowledge they need in daily life may adversely affect their quality of life. In this regard, the Ministry of National Education can organize in-service training, and relevant non-governmental organizations can hold seminars and conferences so that teachers will have sufficient knowledge and experience on dyscalculia.

Within the framework of these results, some suggestions were made to teachers and researchers. In this study, it was determined that most of the teachers did not have sufficient knowledge about what dyscalculia is, made incomplete and incorrect definitions, and confused dyslexia with dyscalculia. In addition, it has been revealed that teachers do not have sufficient knowledge about the causes of dyscalculia, the characteristics of dyscalculic children, intervention methods and effects for these children. In this context, courses for learning difficulties and dyscalculia can be given as compulsory or elective in universities. Articles, books, projects, activities, etc. can be made by researchers to increase awareness of dyscalculia. Thesis studies on dyscalculia can be done at both master's and doctorate levels. On the other hand, in-service training can be given to increase the knowledge level of teachers.

Ethics and Conflict of Interest

This article is based on the seminar held on 21 November 2019 hosted by the Muş Directorate of National Education. The authors declare that they acted in accordance with the ethical rules throughout the research process and that there is no conflict of interest between the authors.

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