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RESEARCH PAPER

Dilemmas Confronted by Special Education Teachers in Facilitating Mathematical Competencies among Individuals with Intellectual and Developmental Disabilities

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ABSTRACT

Mathematical skills are important for individuals with intellectual and developmental disabilities (IDDs) to function and be independent in their daily life. Learning math skills is more crucial since people with IDDs have weak social, practical, and conceptual skills. The main purpose of this quantitative study is to identify the problems faced by special education teachers in teaching mathematical skills to students with IDDs. Population of the study consisted of special education teachers working in Lahore. A sample of 80 special educationalists selected purposefully from different special education schools in Lahore. Researchers used self-developed questionnaire to take responses from respondents. Researchers analyzed the data by using parametric statistic. Frequency distributions of teacher's responses were calculated. Major findings revealed that special education teachers face a little problem in teaching pre-number concepts but face a lot of problems in teaching division, subtraction and addition in mathematical operations. Conclusion was drawn and recommendations were given to parents and teachers to overcome the issues regarding mathematical skills of students with IDDs.

KEYWORDS Mathematical Skills, Special Education Teachers, Students With Intellectual And Developmental Disabilities

Introduction

Mathematical abilities are crucial for academic learning and are required for carrying out daily chores including shopping, cooking, and time management. Basic mathematical and arithmetic skills are essential for fostering social inclusion and independence in children and people with intellectual and developmental disability (IDD). Students with IDD having a strong number sense in the early years predicts future success in developing other mathematical skills that are crucial to daily living. Mathematical skill acquisition is possible for students with ID and their numerical development is similar to that of students who are usually developing. However, their skills rarely go beyond basic numeracy, and they require more time and practice to understand mathematical concepts (Susanne & Pirjo, 2021).

Intellectual and developmental disabilities (IDDs)

An intellectual and developmental disability (IDD) is defined by severe limitations and general deficits in both intellectual and adaptive functioning, according to both the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders and the American Association on Intellectual and Developmental Disabilities. The majority of

people with ID frequently have difficulty comprehending and effectively applying math concepts (American Psychiatric Association, 2013).

The daily lives of all people involve a significant amount of mathematics, which is frequently disguised. It is a "functional skill," and persons with ID need it even more because it will help them live as independently as possible as adults, improving their long-term health and well-being (Brown et al.,2011).

Understanding the difficulties faced by people with disabilities and identifying research-supported teaching methods that will help them learn daily living skills are crucial as these people are incorporated into society. Basic numeracy is one of the most prevalent necessities for people with or without impairments, and is a skill area that is regarded important for work as well as an essential part of independent living (Kellems et al., 2013).

Importance of numeracy skills

The importance of numeracy skills in the daily lives of individuals with IDD is universally acknowledged. The ability to use numbers is essential for organizing and making sense of the world. They are crucial for daily activities, which contribute to independence and social engagement, such as paying for items, checking one's change, or cooking. In a broader sense, numeracy involves the capacity to contextualize and apply the meanings of numbers to circumstances encountered in everyday life (Schnepel et al., 2020).

Mathematical training for individuals with intellectual disabilities often emphasizes fundamental mathematical concepts and skills that are crucial for an acceptable involvement in social life. Children without disabilities often pick up these skills without having much difficulty, whereas children with intellectual disabilities frequently leave school without understanding basic arithmetic ideas (Khul et al.,2012).

Teaching mathematical skills to students with Intellectual and developmental Disabilities(IDDs)

The problem is that there are several different learning strands included in math training. Only one area is number identification and counting. Students are required to start developing their geometry, algebra, data analysis, and measurement skills as early as kindergarten. In order to master higher grade-level objectives, kids with major intellectual disabilities may still struggle with early math skills (such as number recognition and rote counting skills). This can make it difficult to plan arithmetic lessons for students with severe intellectual disabilities (Jimenez et al., 2011).

Challenges of developing first grader students with intellectual and developmental disabilities(IDDs)

The challenge of developing first-grader students with intellectual and developmental disability thoughts about numbers, the notion of numbers, and the characteristics of a sequence of pure numbers is highly challenging. Only by making significant use of visual aids and accounting for each child's unique abilities and prior knowledge can it be resolved. The notion of numbers and arithmetic develops very slowly in mentally impaired kids due to the concreteness of their thinking and their inability to generalize the things they perceive (Khamidova, 2021).

Five different tasks that include working with students with IDDs can be separated out:

- Consider possible expectations while keeping an eye on students' talents.
- Differentiate learning objectives in accordance with identified abilities.
- scaffolding can be used to make up for limited talents.
- Improve a specific learning objective in light of the capability.
- Coordinate collaborative learning while addressing the ability.

Fundamental skills for mathematical ability

Without a doubt, having a solid foundation in mathematics is essential for success in subsequent learning. This includes both fundamental skills and a comprehension of fundamental concepts, both of which can be developed through interventions. Pre-knowledge refers to providing learning chances for the specified fundamental conceptual knowledge and fundamental motor abilities, such as by modifying the curriculum for some children. Inclusionary strategies like In order to ensure accessibility for all students with reference to the cognitive abilities of selective attention, working memory, or metacognitive control, Universal Design for Learning has been established. In terms of language competence, instructional practices can either reduce the amount of superfluous language demands placed on children or help them speak more fluently by giving them the proper opportunity to acquire a language (Susanne,2021).

Techniques for teaching mathematical skills

With the aid of assistive technology, students with disabilities—especially those who have an intellectual and developmental disabilities (IDDs) can support and enhance their learning, independence, and daily life skills. We decide to focus on assistive technology for children with IDDs in two areas: transition and independence and educational aids with a focus on reading, writing, and math (Bouck et al.,2023).

A helpful co-teaching technique is used to educate students with intellectual and developmental disabilities (IDDs) in regular classroom settings. There are five approaches of co teaching for students with IDDs.

- Supportive teaching is when one teacher runs the class while the other offers one-on-one or small-group assistance to the students. In this arrangement, one teacher directs the lesson while the other serves in a supportive capacity by offering one-on-one help to students who require it.
- Station teaching, in which each teacher is in charge of one or more learning stations and pupils are separated into two or more stations for instruction. Students in this approach alternate between different stations.
- Alternating or complementary teaching involves dividing the class into two groups, one small and one big, with each group receiving supplemental education from one of the co-teachers.
- Team teaching, in which the two co-teachers jointly plan, instruct, grade, and oversee the entire class.
- Separating the class into various groups and having each teacher provide the same or a comparable lesson is known as parallel teaching. (Strogilos et al.,2015).

Math's significance in daily life cannot be emphasized. Some of the skills required for independent living include the ability to budget and pay for groceries. Although conceptual knowledge and reasoning are now the main focuses of mathematics training, employing arithmetic in daily life is still impossible without mastery of fundamental math facts. But many students with mild to moderate intellectual disabilities finish school without gaining these crucial foundational skills (Jansen et al.,2013).

Role of mathematical skills in daily life

Mathematical skills are required in many different aspects of daily life, including pricing calculation, distance measurement, amount estimation, and many more. Furthermore, there is mounting evidence that mathematical aptitude is not a monolithic concept but rather a composite of numerous sub-components. Individuals may have obvious differences between several component (Yakubova et al.2023).

Mathematical skills are influenced by a variety of cognitive and non-cognitive factors, including working memory, language, attention, visual learning, and non-cognitive factors (such as environment, motivation, and math anxiety) are all connected to higher cognitive abilities and domain-specific knowledge (such as subtitling, counting, magnitude processing, basic number skills, and fact retrieval (Desoete et al.,2020).

Working memory and mathematical aptitude are related, but the relationship is moderated by the task and the age of the student. Visuo-spatial memory functions as a mental whiteboard for counting and arithmetic tasks to enable numerical representation, including column alignment and place value. Tasks that required ranking numbers, transferring numbers from one representation to another (for instance, from words to numbers), quantity discrimination, and were used to assess students' mathematical abilities were among the more challenging number skills, such as arithmetic computation (Tracy& Maria,2011).

Gender disparities in mathematical skills

Gender disparities in mathematical aptitude may also be influenced by learning styles and cultural factors. It is interesting to observe that the age trend in these gender inequalities in mathematics exhibits regional variances. It is believed that arithmetic problems, also known as arithmetic word problems, serve as a bridge between a child's growing computational capabilities and his or her ability to use these skills in real-world situations (Rosselli et al.,2009).

For all children, including those with developmental challenges, math instruction is crucial. At the most basic level, people use mathematics in all aspects of their daily lives, from grocery shopping to budgeting to filing taxes. For students with developmental impairments, a solid grasp of mathematics supports not only functional skills—or day-to-day life abilities, such as employment—but also access to higher level mathematics, as mathematics builds upon itself (Bouck et al.,2020).

There are some guidelines while teaching mathematics to students with ID.

- Step away from the textbook alone: There isn't much material in textbooks on teaching students with IDD on teaching mathematics outside of more conventional subjects like money and measurement. These subject areas are just a small selection of the mathematics curriculum that is advised.

- Regardless of a student's differences, educational games are a resource that can be used in place of textbooks and other conventional resources to encourage inclusion.
- Students with IDD are likely to benefit from visual representations. Students can utilize concrete or visual manipulatives, for instance, to help them solve mathematical problems. They are particularly beneficial for solving issues involving addition and subtraction.
- Using technology, students with ID can have more access to the core curriculum and obtain better learning outcomes.
- Students with ID require teaching that combines academic and functional mathematics objectives. Practical math is taught using real-world examples in functional mathematics (Prendergast et al.,2017).

Activities for teaching mathematical skills

Early childhood mathematics learning possibilities can be divided into include official activities, such as lectures on quantity, and casual ones, such as playing a board game involving numbers. The distinction between informal and formal in the context of the home and preschool environment pertains to the nature of the activity rather than the necessary mathematical abilities. The government-mandated official instruction of mathematics typically does not begin until the student reaches school, despite the fact that young children are exposed to both sorts of experiences at home and in daycare facilities for preschoolers. Even before they start formal schooling, there are large differences in children's early mathematical experiences, which are predictive of long-term mathematics success. Children memorize the count sequence before they can understand the numerical significance of number words and Arabic numerals. Importantly, children are only assumed to understand symbol meanings precisely. Early emphasis on symbolic abilities may have long-term effects on the development of mathematics. Evidence from young toddlers, as well as neurological and behavioral data from school-aged kids, has shown significant connections between understanding of symbolic numbers and mathematical achievement (Merkley et al.,2016).

Instructional strategies teaching mathematical skills

It is possible to learn how to think critically, but it takes practice. The use of instructional strategies that actively involve students in the learning process rather than relying on lectures and note-taking, the focus of instruction on the learning process rather than just the content, and the use of assessment methods that provide students with an intellectual challenge rather than memos are all ways that mathematics educators at the secondary and post-secondary levels can help students develop their critical thinking skills (Hagopian et al.2023).

There are a number of obstacles that could prevent the teaching of critical thinking. Critical thinking-promoting learning environments are under danger due to a lack of training, a lack of resources, ingrained biases, and time restraints. In contrast, if teachers actively include students in project-based or collaborative activities and use effective questioning techniques, this can increase the development of critical thinking in their pupils (Peter,2012).

Working memory is the phrase used to describe a system in charge of short-term knowledge storage and manipulation required for carrying out challenging cognitive activities including learning, thinking, and comprehension. Working memory serves as a

mental workspace that can be effectively employed to support routine cognitive tasks that call for both processing and storing, such as, for instance, mental arithmetic (Tracy,2007).

There are many facets to mathematics. Math instruction in primary school focuses on teaching arithmetic fact fluency, operations, and word problem solving. The automatic recall of straightforward one-digit addition and subtraction facts, as well as multiplication knowledge in later primary years, is referred to as arithmetic fact fluency. Solving linguistically expressed mathematical relations and properties problems is referred to as word problem solving. Evidence indicates that word problem performance among children with IDD and typical performers is comparable (Rose et al.,2010).

By the time they start kindergarten, young children's math abilities vary greatly

1. The majority of youngsters can count to ten when they start school, but only 5% of them can already perform basic math operations, and another 5% are unable to identify numbers.

2. Despite improvements in the math skills kids have learned before entering kindergarten, variability in these early skills has not altered significantly over the previous 10 years.

3. Since early math abilities are among the most important, it is crucial to comprehend why some kids enter school more equipped to understand math than others.

4. Years of study have shown that the home literacy environment, which includes activities like reading to kids and having in-depth interactions with them, can improve kids' language and literacy abilities.

5. The same is true for activities that expose kids to arithmetic concepts, such as counting, playing board games, and talking about money, which is what we refer to as the "home numeracy environment" (Elliott et al.,2017).

Teaching students with intellectual and developmental disabilities(IDDs) the mathematical information and skills they will need for their future occupations and daily lives, as well as fostering the ability to use these knowledge and abilities throughout their lifetimes, is the primary general educational task of mathematics education. These are the key responsibilities that need to be considered when deciding what mathematics should be taught to secondary school students. Mathematics must address educational, pedagogical, and practical issues, just like any other discipline (Ogourtsova et al.2023).

Students learn how to think rationally and communicate themselves effectively and fluently in both oral and writing discourse via the use of mathematical materials and exercises. Teaching arithmetic skills in the development of cognitive abilities such as cognition, memory, thinking, imagination, and mastery of mathematical information and skills in individuals with intellectual impairments. The ability to undertake mental operations including analysis, synthesis, comparison, generalization, and concretization is made possible by corrective effort focused at improving mathematical knowledge, skills, and abilities (kisley et al.2023).

There are following guidelines for the development of cognitive activity in students of specialized secondary schools:

- play activities that are aimed at solving the educational goals and objectives of the topics covered in the program.

- the use of games in mathematics that help students to engage in communication, or to acquire a communicative culture.
- helps players overcome obstacles to learning math in both life and play.
- The game offers a chance to develop socially acceptable behavior in order to fill up any gaps in their understanding of mathematical principles
- the game's logical design makes it appropriate for students who are intellectually challenged (Khamidova, 2021).

Application of knowledge and skills

For students with disabilities, solving mathematical problems that call for the application of knowledge, skills, and techniques to novel issues can be challenging. Most disabled students struggle with knowledge construction, concept development, and articulation. Of concepts as well as logic. Math learning challenges and unique educational needs are common among students with modest intellectual impairments. These kids may struggle to recall information, conceptualize issues, and employ efficient ways to complete math activities. Most typically to recognize significant information and translate linguistic and numerical information in word problems into the appropriate mathematical equations and procedures. Furthermore, it is generally accepted that kids with mild intellectual disabilities find it difficult to apply effective cognitive and metacognitive problem-solving strategies, memory capabilities, and generalization or transfer skills. Teachers would benefit if instructional materials and programs included performance generalization approaches and strategies to help students succeed in mathematics subjects (Chung et al.,2005).

Material and Methods

The type of the research was quantitative and conducted through survey with the help of a questionnaire. The population of study was all teachers teaching student with IDDs in Lahore. The sample of the study consisted of 80 teachers and was selected purposively from different institutions in Lahore. To achieve the objectives of study, researcher used a self-developed scale. The scale consisted of two parts. The first part of scale consisted of demographic information of teachers (name, qualification, experience, school name and city name) and the second part consisted of questions about problems of special education teacher to teach the students with IDDs. Researcher used close ended questions with 5 options (0%, 25%.50%, 75%, 100%). The reliability of the scale was estimated with the help of Cronbach alpha (α=.87). The parametric analysis was performed on the data. Frequency of the responses along with percentages,Independent sample t-test and Mode was performed to analyze the data.

Results and discussion

Table 1
Pre-number concepts

Sr.no	Statement	0%		25%		50%		75%		100%	
		f	%	*f*	%	*f*	%	*f*	%	*f*	%
1	At what extent, you face problem in teaching the concept of big and concept of small?	11	11.1	41	41.4	20	20.2	8	8.1	-	-
2	At what extent, you face problem in teaching the concept of tall and short?	18	18.2	42	42.4	13	13.1	7	7.1	-	-

3	At what extent you face problem teaching the concept of thick and thin?	15	15.2	19	19.2	21	21.2	23	23.2	2	2.0
4	At what extent you face problem teaching the concept of full and empty?	18	18.2	42	42.2	10	10.1	10	10.1	-	-
5	At what extent you face problem teaching the concept of simple shape circle?	27.1	27.3	38	38.4	7	7.1	6	6.1	2	2.0
6	At what extent you face problem teaching the concept of simple shape triangle?	13	13.1	47	47.5	9	9.1	9	9.1	2	2.0
7	At what extent you face problem teaching the concept of simple shape square?	15	15.2	40	40.2	13	13.1	8	8.1	4	4.0
8	At what extent you face problem teaching the concept of shape rectangle?	7	7.1	30	30.3	12	12.1	21	21.2	6	6.1

According to 41.4% teachers, they face 25% problems to teach the concept of big and small. 42.4% teachers reported that they face 25% problems to teach the concept of tall and short. 23.2% teachers reported they face 75% problems in teaching the concept of thick and thin. 42.2% teachers reported they face 25% problems to teach the concept of full and empty. 38.4%of teachers reported that they face 25% problems to teach the simple shape circle. 47.5% teachers reported that they face 25% problems to teach the simple shape triangle. 40.2%teachers reported that they face 25% problems in teaching concept of square. 30.3% teachers reported that they face 25% problems to teach the shape rectangle.

Table 2
Number concept

Sr.no	Statement	0%		25%		50%		75%		100%	
		f	%	*f*	%	*f*	%	*f*	%	*f*	%
9	At what extent you face problem teaching the concept of digit recognition?	4	4.0	23	23.2	24	24.2	22	22.2	3	3.0
10	At what extent you face problem teaching the concept of sequence of numbers?	5	5.1	25	25.3	11	11.1	28	28.3	7	7.1
11	At what extent you face problem teaching the concept of number values?	2	2.0	17	17.2	14	14.1	27	27.3	16	16.2
12	At what extent you face problem teaching the concept of forward numbers?	6	6.1	18	18.2	22	22.2	19	19.2	11	11.1
13	At what extent you face problem teaching the concept of backward numbers?	4	4.0	7	7.1	13	13.1	29	29.3	23	23.2
14	At what extent you face problem teaching the concept of counting the objects?	11	11.1	25	25.3	15	15.2	17	17.2	8	8.1

According 24.2% teachers reported that they face 50% problems to teach the concept of digit recognition. 28.3% teachers reported that they face75% problem teaching the concept of sequence of numbers. 27.3% teachers reported that they face 75% problems to teach the concept of number value. 22.2% teacher reported they face 50% problems in

teaching forward counting. .29.3% teachers reported they face 75% problems in teaching backward counting. 25.3% teachers reported they face 25% problems in teaching counting objects.

Table 3
Mathematical Operations

Sr.no	Statement	0%		25%		50%		75%		100%	
		f	%	*f*	%	*f*	%	*f*	%	*f*	%
15	At what extent you face problem in teaching the addition with carry?	3	3.0	12	12.1	18	18.2	16	16.2	24	24.2
16	At what extent you face problem in teaching addition without carry?	11	11.1	9	9.1	10	10.1	19	19.1	24	24.2
17	At what extent you face problem in teaching subtraction with carry?	3	3.0	7	7.1	6	6.1	27	27.3	30	30.3
18	At what extent you face problem in teaching subtraction without carry?	4	4.0	10	10.1	12	12.1	15	15.2	32	32.3
19	At what extent you face problem in teaching multiplication?	2	2.0	7	7.1	8	8.1	18	18.2	38	38.4
20	At what extent you face problem teaching the concept of division?	3	3.0	3	3.0	12	12.1	10	10.1	45	45.5

According 24.2% teachers reported that they face 100% problems to teach the concept of addition with carry .24.2% teachers reported that they face 100% problems to teach the concept of addition without carry. 30.3 reported that they face 100%% problems to teach subtraction with carry. 32.2% teacher reported they face 100% problems in teaching subtraction without carry. 38.4% teachers reported they face 100% problems in teaching multiplication. 45.5% teachers reported they face 100% problems in teaching division.

Independent Sample T test:

Researcher used independent sample t.test to know the problems of special education teacher teaching mathematical skills to students with IDDs on the basis of their gender.

Table no 4

Independent Sample T test

Levene, s test for equality of variance				
f	Sig	t	df	Sig (2-tailed
.026	.873	-1.390	71	.169

There is no significant difference between the problems of mathematical skills on the both gender (male, female) specifically, our results suggest that problems of mathematical skills doesn't vary on the basis of the teacher's gender.

Mode

Researcher used statistic (mode) to know which most problems in mathematical skills are.

Table no 5
Mode

At what extent you face problem in teaching the addition with carry?	At what extent you face problem in teaching addition without carry?	At what extent you face problem in teaching subtraction with carry?	At what extent you face problem in teaching multiplications?	At what extent you face problem teaching the concept of division?
5	5	5	5	5

This shows that mathematical operations are difficult for teachers to teach the students with IDDs.

Discussion

This literature review focused on problems of special education teachers in teaching mathematical skills of students with IDDs. Specifically, this study reviewed the problems in mathematical concepts. The most frequent problem faced by special education teachers was mathematical operations. As pointed out by Bouck et al.(2023),assistive technology could help in teaching mathematical skills of students with IDDs. Improving the ability to solve mathematical word problems is one of the most critical issues facing students with intellectual and developmental disabilities(IDDs), because it is directly related to their independent living skills (Morris et al.2023).

Conclusion

The aim of this study was to know the problems of special education teachers teaching mathematical skills to students with IDDs. Mathematical skills are important to live independent life. Although teachers use different educational materials and courses incorporated strategies and performance generalization techniques, enabling students to do well in their mathematics classes but special education teachers face a little problem in teaching pre-number concepts and face a lot of problems in teaching mathematical operations. Special education Teachers face 75 to 100% problems in teaching the concept of subtraction, multiplication, division.

Recommendations:

Results of this quantitative study recommend special education teachers to take following steps:

- Special education Teachers should use Assistive technology to overcome the problems in teaching mathematical concepts of students with IDDs.

- Special education teachers should use different instructional techniques in teaching mathematical operations of students with IDDs.
- Special education Teachers should modify mathematical skills according to needs of every student with IDDs.
- Special education Teachers should provide guidelines the parents to improve the mathematical abilities of students with IDDs.
- Teacher-Training courses should be conducted for teachers to deal problems in teaching mathematical skills of students with IDDs.

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