

Impact of AI tools on the Development of Functional Math skills of Children with Intellectual Disability at the Primary Level

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ABSTRACT:

Functional math skills are important for everyone for an independent life. Human interaction is being forced to be replaced by technology. The impact of functional math skills on children is limited due to attention towards technology and artificial intelligence (AI) tools. This study aims to connect AI tools like ChatGPT and Google AI Studio to develop the functional math skills of children with mild to moderate intellectual disability. A quasi-experimental study design was employed, consisting of an intervention group (n=20) and a control group (n=20), which included both a pre-test and a post-test. The Madras Developmental Programming System was used before and after the intervention. The study results were significant with $p < 0.05$. The skills like addition, subtraction, and multiplication were developed. The limitations and future work are also discussed.

Keywords: AI tools, math skills, technology, MDPS, intellectual disability, functional skills.

Introduction

AI tools play a vital role in enhancing functional maths skills by offering personalized, real-time feedback and adaptive learning experiences. They support users in improving addition, subtraction, and multiplication more effectively. In educational and therapeutic contexts, AI-powered apps help individuals, including those with math delays or disabilities, to develop math skills through consistent, tailored practice. These tools also assist slow-learning students in learning math and enable a creative learning space through writing prompts and games. Overall, AI fosters greater confidence, accessibility, and fluency in learning math across diverse learning needs. The

biggest help for those with impairments to live independent lives in the twenty-first century is technology and digital media. The use of computers and mobile devices in the classroom to teach mathematics to pupils has significantly increased over the past several decades (Min Wook). Since numerous studies demonstrate the benefits of adopting digital tools for mathematics learning, students need user-friendly software and apps to improve their comprehension and increase their active learning. Digital resources are more easily available, engaging, and useful for comprehending the (Nor Ayishya Sat). The most promising development pathways for kids with ID seem to be digital media (Lussier, 2017). The

primary components of the current study are to develop expressive language skills for independent life. One of the study's distinctive features is the use of an AI Tool to help kids with ID improve their skills by having them complete easy online activities. The need for digital assistance, expressive language abilities, and an independent life must be explored to use it to the maximum for the wellness of children.

Related studies

The related studies, including AI tools in developing math skills of intellectual disabilities, are limited. Few studies are discussed. Drljić conducted a thorough analysis of the mathematical challenges and digital technologies. It divided the material into six main headings, which included math challenges, cognitive and psychological processes, impediments, and various forms of digital technologies and frameworks that address these issues. Resources, both digital and non-digital, mathematics education and learning, mathematical aptitude, and openness to learning. Klingenberg concentrated on compiling the reviews of digital arithmetic instruction for visually impaired students. He concluded that interactive online learning combined with tactile and aural learning can help kids improve their math abilities. It also came to the conclusion that there is insufficient data to support the idea that digital tools can help visually impaired people learn math. Kumaş investigated the effectiveness of digital stories as a cutting-edge method of teaching math to young students with intellectual disability. To improve the educational process, he combined text, audio, and graphics in a multimedia approach. The study showed a promising strategy for enhancing young math proficiency in kids with minor learning impairments. Additionally, the results indicated that incorporating digital storytelling into special education courses could enhance students' mathematical proficiency.

In a pilot study, Lindau documented the impact of a brief digital intervention on perceptions of intellectual disability. When used as an intervention, film-based teaching had a slight positive impact on the attitudes of individuals

with intellectual disabilities. For the discernible effect, the study also recommended a web-based intervention. Maed-Math investigated how mathematics instructional videos mediated the relationship between students' academic motivation and teaching tactics. Discovered a strong correlation between math tutorial videos, academic motivation, and teaching methods. Faragher engaged in research concerning numeracy tailored for a digital environment specifically for learners with Down syndrome, centering on the notion of functional mathematics. This study investigates the impediments through the theoretical framework of educational quality of life and the advancement of numeracy, while emphasizing the creation of a suitable mathematical curriculum designed to foster enduring numeracy skills. Ryan O. used an augmented reality-based training package to examine the efficacy of video-based arithmetic instruction on seven middle school students with distinct learning disabilities. To answer multistep arithmetic tasks, such as adding, subtracting, multiplying, and dividing integers, converting measurements using ratio reasoning, and calculating the rate of change through multiplication and division, the study employed the video model. The trials' findings showed that following the intervention, every stage of the math issues was fixed. Well-designed computer-assisted instruction with effective instructional variables should be regarded as a promising intervention to support mathematics instruction, according to Min Wook's review of the impact of computer-assisted instruction on the mathematical performance of students with learning disabilities. Park examined the results of a synchronous online intervention for kids with learning difficulties that employed virtual manipulatives to teach them about equivalent fractions. Using interactive whiteboards and one-on-one video conferences, fifteen fraction lessons were taught. Improvement was observed as a result of the intervention, even if the degree and sustainability of the improvement varied. Sheila Lestari Giza researched how individuals with disabilities might access information through digital applications. The results showed that those who are deaf and blind benefit from

having access to information via digital applications. Life is becoming more accessible and independent thanks to this technology. Min Wook investigated how pupils with learning difficulties performed in math after receiving computer-assisted instruction. The findings showed that learning mathematics is impacted by both a significant maintenance effect and a medium intervention effect. Rafiquddin thoroughly examined the early literacy intervention digital training for special education teachers. With an intervention group and a control group, Vereenoghe sought to co-develop a digital psychoeducational intervention to enhance the mental health of individuals with intellectual disabilities. This study showed that developing innovative digital treatments can involve individuals with ID. Children with ID and sensory impairments may now carry out everyday tasks on their own thanks to Lancioni's smartphone intervention. Every participant in this trial received a smartphone along with instructions at a predetermined time. The intervention helped improve performance in day-to-day tasks. Silvia Benavides-Varela examined how well the digital-based intervention worked. When a digital-based intervention was used, math skills improved. However, there is no proof that video games provide any further benefits over digitally based coaching and drilling methods. Considering all the above studies, the researcher group.

planned the intervention to help children with intellectual disabilities improve their math skills. This study aimed to integrate an AI tool for developing functional math skills.

AI tools for developing functional math skills

AI tools are helping to develop functional math by making learning easier, faster, and more accessible. They offer personalized addition, subtraction, and multiplication through virtual conversations. AI is also being used to develop arithmetic skills like addition and subtraction and create learning content for schools. Speech recognition, text-to-speech, and chatbots make language practice interactive and available anytime. These tools are especially helpful in areas with limited access to teachers or resources. Overall, AI supports both learning and preserving functional math skills around the world.

AI tools have a greater impact on the development of the functional math skills of children with disabilities. The integration of AI tools in developing functional math skills more important area in today's world.

Methodology

The study employed a quasi-experimental design (Zilaey, 2017) with a pre-test and a post-test, involving 20 students in the intervention group and 20 students in the control

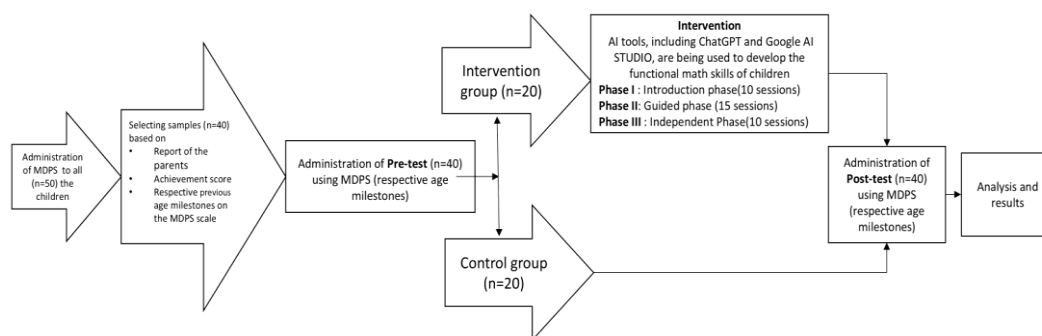


Figure 1: Impact of an AI tool on the development of functional math skills of children with intellectual disability at the primary level

Participants

Forty primary school children from a special school for children with intellectual disabilities participated in the study. Mild and moderate

children (Bouck et al., 2018; Karabulut & Özmen, 2018; Bouck & Long, 2020, Saunders et al., 2018; Browder et al., 2018; Orihuela et al., 2019; Jimenez & Saunders, 2019; Chapman et al., 2019)

were included in the study, considering the educational ground of the severe and profound ID children renders them unable to acquire skills (McKenzie et al., 2017, J.C. Wright, et al,2020). Though the prevalence of ID is greater in males (McKenzie et al., 2016), the present study aimed to include both genders to promote equality. Less research is done on the functional math skills

through AI tools of ID at the primary level, for students aged 6 to 14, because a solid foundation for functional math skills can be established at the primary level. The participants' demographic data are displayed in Table 1. These kids are enrolled in a special education program that uses the state board curriculum. English serves as the students' primary language of education.

Table 1: Demographics of the participants in the intervention group

Variables	Category	Number
Gender	Male	16
	Female	4
Age	6 to 9	12
	9 to 12	8
Grade	2 & 3	14
	4 & 5	6
Primary diagnosis	ID	10
	ID & ASD	10

Materials

The Madras Developmental Programming System (MDPS) is a tool developed to assess the functional skills of intellectually disabled children in the Indian context. It consists of 18 domains. Domain 12 (Table 2) focuses on numbers, which

are highly related to the expressive language skills of intellectually disabled children. It is sequenced based on the years. Pre-requisites to learn age-appropriate functional math skills are considered. For example, if the child is in the 4th grade, the previous skills are considered prerequisites.

Table 2: The MDPS scale domain 12: Numbers

Age level in years	Item number	Domain-12 Number	Score
0-5	1	Rote counts 1-5	
	2	Separates one object from a group upon request	
	3	Discriminates between less and more	
	4	Matches identical number of concrete objects	
5-7	5	Recognises written numbers from 1-10	
	6	Write numbers sequentially from 1-10	
	7	Picks up specified number of objects up to five	
	8	Arranges the number symbols sequentially from 1-5 in an order	

	9	Follows directions to fill up to half a glass	
	10	Add single-digit numbers up to 10	
	11	Subtracts a single digit number within 10	
	12	Writes numbers up to 100 on random dictation	
7-9	13	Does a two-digit addition without carry over	
	14	Does a two-digit subtraction without borrowing	
	15	Does two-digit addition with carryover	
	16	Does two-digit subtraction with borrowing	
9+	17	Name math symbols	
	18	Measures liquid using measuring cups	
	19	Weighs objects using a weighing scale	
	20	Uses a calculator for basic arithmetic operations	

Intervention Design

The intervention consisted of 30 sessions and was divided into 3 phases, continuously in two months. Phase 1 consists of an introduction with 10 sessions, the second phase is the guided phase with 10 sessions, and the third phase is the independent phase with 10 sessions. Each session has a duration of 40 minutes. The activities planned are student-centered. They are allowed to ease and take breaks in between the sessions. All the students were given an orientation about the study and the materials, like a mobile phone and a computer. A few activities were also shown to the students in the orientation sessions. For each student, an Individualised Education Plan (IEP) was prepared by the teacher according to the needs and level of the student. The word problems, which are highly related to independent skills and vocational skills, are taken from their regular textbook. The selected problem will go through the steps. Students will be assessed every 5th class of the study as an informal test. Phase 1 will be an essential and rapport-building stage between the student and the teacher. The teacher-to-student ratio was 1:2. Prompting like “Did you find the number?” “What operation is to be done?” “Any difficult words?” was asked. Errors were corrected after each step (Sarah, 2020). The verbal and non-

verbal reinforcements are given when needed. During the initial guided phase, a few steps are demonstrated. Each step is guided by the teacher using a task analysis. Statements like “very good”, “you can do more”, “you are the best”, and “that’s great work” were used to encourage the participants to complete steps and problems. Mistakes in the problem were corrected in parallel during each session. Guidance and prompting were gradually reduced in the later part of the phase. In the independent phase, the students were encouraged to use the AI tool independently. Encouraging statements are given only at the end of the solution. Though students required assistance at the beginning of the phase, independence in solving problems was practiced by the students at the end of the phase. Follow-up sessions were also conducted after the intervention. In this phase, only the concepts and themes were given as homework. Students are asked to use the AI tool and develop the concept. During the follow-up sessions, the majority (79%) of the children solved the given problem independently.

Result The pre-test was conducted just before the intervention. The children were not aware of the intervention, methods, and materials during the pre-test. The post-test was conducted after the 30 sessions of intervention.

Table 3: Scores of the intervention group on the MDPS scale

S.N O	Pre- test(100)	Post-test (100)	Follow-up (100)	Differences (pre- and post-test)	Varianc e	SD	t- valu e	p- value
1	50	79	83	29	169			
2	35	81	82	45	9			
3	40	85	90	45	9			
4	20	77	76	57	225			
5	15	45	56	30	144			
6	21	76	81	55	169			
7	12	89	91	77	1225			
8	43	74	84	31	121			
9	39	87	88	48	36			
10	36	80	84	44	4			
11	26	62	77	36	36			
12	44	89	92	45	9			
13	44	60	84	16	676			
14	59	92	92	33	81			
15	56	91	90	35	49			
Aver age	36	77.8	83.333333	41.73333333	197.466 6667	14.05 228	9.39 3	0.0000 001

The names of the students were noted as serial numbers.

During the pre-test, the mean score of children on MDPS was 36%. In the post-test, the score on MDPS increased to 77%. It shows that the intervention was effective. The follow-up sessions were highly beneficial for the children, with a score of 83%. The score on table 3 of the control group on MDPS shows less difference, indicating that there was no significant difference in the regular teaching. The scores of the intervention group (36%) and the control group (36.5%) during the pre-test were almost equal. The post-test scores of both groups are significant.

The post-test scores of the intervention group (n=20) on the MDPS scale were higher than those of the control group (n=20), with a p-value

of 0.0000001. There was a 41% increase in the post-test score on MDPS compared to the pre-test. The paired test was performed on the MDPS. When analysing the pre-test and post-test scores, it stands significantly with a p-value of 0.00000001. Since $p < 0.05$, the intervention had a significant impact on the experimental group.

Discussion

A total of twenty sessions were scheduled. The number of sessions for each student varied (mean=20) because each student's IEP (Alber et al,2001) was customized. Better performers required fewer sessions than those who needed more time to grasp the content. During the first phase, students faced problems adapting to the teacher and materials.

The feedback from the students was “using the AI tool was interesting and more engaging than the regular books”. “Children started to do their screen time effectively at home every day”, said the parents. This shows that the students were interested in doing their daily activities more independently than ever before. The teachers regularly reported that the students started to think and connect conversations in the AI-based activities. By doing those activities, children also developed their eye-hand coordination, healthy habits, and happiness in living an independent life. Unconsciously, they develop skills like problem-solving and critical thinking. Additionally, non-targeted skills like cooperation among the team, listening, waiting for the turn, spelling, reading, and understanding the meaning of the sentences are also achieved. The findings show that these activities not only help in developing functional skills but also using the screen time effectively. The skills needed for modern independent life are outcomes of refined technologies. The results line up with the earlier

findings of the contribution of ethnomathematics to academics.

Future work

Based on the study, it can be recommended to learn the other concepts in math, reading, writing, and science can also be learned through AI tools. More studies should be done on children with severe intellectual disabilities, with a larger sample in teaching functional math skills. Functional math skills are highly related to vocational skills, which are an important key factor in leading an independent life.

Conclusion

Using AI tools is not only fun but also encourages students to think in ways they can understand. Personalized learning, real-time feedback, flexible access, and increased engagement will be enhanced. It illustrates that there is no strict division between independent skills and AI Tools activities. AI Tools contribute to a healthy and independent human lifestyle.

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Video Self-Modeling on an iPad to Teach Functional Math Skills to Adolescents with Autism and Intellectual Disability

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