USE OF ICT IN MATHEMATICS EDUCATION FORSTUDENTS WITH SPECIFIC LEARNING DISABILITIES (SLD) IN THE POST-PANDEMIC ERA: A NARRATIVE REVIEW

Abstract

With the spread of the global health crisis due to Covid-19 followed by the lockdown, there has been a significant surge in usage of Information and Communication Technologies (ICT) in educational institutions especially Higher Educational Institutes (HEIs), across the globe. Such digital tools support the advancement of both typical and neurodiverse students such as those Students with Specific Learning Disabilities (SwSLD) who need additional support through content modification, adaptability, and accommodation due to the numerous unique challenges faced by them in academics. ICT has played a pivotal role in facilitating digital adoption and adaptation, offering diverse avenues for content acquisition, assimilation, and retention. In the present chapter ICT and its use for imparting mathematical curriculum to Students with Specific Learning Disabilities has been explored using a narrative review of literature and an attempt has been made to gather evidence regarding its utility towards maximizing learning outcomes. The findings indicate that the efficiency of ICT tools towards enhancing and enriching the learning experiences of students is universally acknowledged, however there is under-utilization of ICT among SwSLD, owing to lack of awareness, absence of required skills among teachers and lack of research focus in this area. The present chapter indicates that ICT is viewed as a useful educational resource with demonstrated motivational benefits, heightened participation levels, and efficacy in reinforcing concepts through engaging electronic computerized games, simulated activities, immediate feedback, and other interactive elements especially in the teaching of mathematics curriculum. Moreover, it serves as an effective time-saving tool for both students

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and educators. The study recommends the need for more studies focusing on use of ICT in mathematics training for students with Learning Disabilities to help cater to their specific needs and maximize learning, especially in the post pandemic era.

Keywords: COVID-19,Digital approach, Digital transition, Learning outcomes, Mathematical education, Mathematical Curriculum, Specific Learning Disabilities.

I. INTRODUCTION

With the spread of the global health crisis, propelled by rising cases of COVID-19, all educational institutions were forced to shift to the online mode to deliver quality educational services to their learners, even as humanity was battling one of the toughest and most challenging health scares. This led to an upsurge in the use of digital technologies, ICT tools and E-Learning for and among students (Alabdulaziz, 2021). However, currently there is a lack of research in the area of ICT and E-learning for teaching mathematics (Mulenga &Marbán, 2020). This necessitates the need to study their utility for the same, with special reference to learners with exceptional needs.

When classroom teaching is delivered through ICT based tools such as gamified learning, mobile applications etc it ensures that the content is grasped with ease, and hence it can prove as a boon for the teaching-learning process even among learners with disabilities at suitable levels and ages (Naidoo&Singh-Pillay, 2021). In a bid to maximize the utilization of e-content, several governmental initiatives have been launched in India in the recent past. Notably, the government has introduced several key features in National Education Policy 2020, which emphasize the provision of availability of e-content in multiple regional languages. Subsequently, the Universal Grants Commission delineated guidelines for developing high-quality e-content catering to students with disabilities as outlined in the Rights of Persons with Disabilities Act (RPwD, 2016). Noteworthy is the budgetary allocation in education sectorto bolster the various ICT linked and ICT-driven initiatives such as allocation of budget for creation of E-content spanning various languages (Bajpai & Biberman, 2022). The budget explicitly underscores the importance of furnishing ICTbased training for educators and furnishing virtual instructional tools or platforms to foster innovative e-content tailored to students with diverse student needs. These steps and measures are taken to support the role of ICT as a driver of equality in education.

Information and Communication Technology (ICT) holds the potential to significantly enhance the quality of education by facilitating a deeper understanding of subject matter and by fostering transformative changes in educational practices. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) advocated for a concerted global effort to recognize the role of ICT in accelerating progress towards Sustainable Development Goals (SDGs) across nations. UNESCO has always supported innovation driven solutions to support mankind by finding the solutions to problems faced by human beings, in order to foster human well-being, sustainability, socio-economic development, democracy and peace through Science, Innovation and Technology (STI). The integration of technology in education is therefore multifaceted, encompassing teacher professional development, enhanced accessibility of educational content for students, increased inclusivity in classrooms, streamlined organizational functioning, and comprehensive management strategies. To facilitate the integration of ICT into the teaching-learning process, UNESCO supports and encourages affirmative instances of ICT implementation across diverse educational contexts worldwide (UNESCO recommendation on Open Science, 2021).

1. **ICT in Education: An Overview:** Information and Communication Technology (ICT) refers to the fusion of communication and computer systems through both wired and wireless networks. The resulting amalgamation facilitates functions such as information storage, modification, monitoring, transmission, and access. ICT encompasses a wide

array of digital elements, including web-based information, software applications and services, tools like computers, laptops, and systems like email, the World Wide Web (WWW), digital textbooks, Compact Discs (CDs), Digital Versatile Discs (DVDs), Overhead Projectors (OHPs), photocopy machines, and other digital instructional programs. These components play a pivotal role in the modern educational paradigm.

The seamless integration of ICT into the teaching-learning process within schools is the core need of the hour and leads to ongoing professional development initiatives for educators. This approach not only equips educators with the requisite ICT skills to integrate technology effectively into pedagogical practices but also underscores the importance of providing continuous support and incentives to teachers as active users of ICT. This approach in turn, sustains their motivation to consistently apply ICT skills within the teaching-learning process, thereby leading to an overall enhancement in educational quality. As part of this endeavour, recommendations are extended to educators, governmental bodies, and organizations to conduct systematic assessments of the impact of ICT on learning outcomes among learners within various educational settings.

2. **Objectives of the Study:** The present study aims ‘to explore the use of ICT tools and E-Learning for teaching and learningof Children with Specific Learning Disability (CWSLD)’ through narrative review of relevant literature.

II. METHODOLOGY OF THE STUDY

This study is narrative review paper which has been executed using an in-depth of study of relevant literature in the form of analysis of recent documents such as published research articles in the form of books, journals, magazines etc.

III. FINDINGS

Numerous studies have supported the use of ICT in education of students, maximising learning student engagement and memory. There are studies which point out the benefits of ICT usage in mathematics education such as the study by **Das (2019)** which clearly indicated that ICT is a core part of our daily lives today. It is highly integrated in the teaching-learning processin today’s classrooms which are often equipped with digital technology such as Smart Boards, Overhead Projectors (OHPs). ICT proves very useful in the teaching of Mathematics by engaging learners in the process of calculating, solving, practicing mathematical sums for students of grade 6^{th}-12^{th}. The paper also explores the use of ICT based mathematic teaching training for teacher educators during their training period thereby helping them to integrate technology in their teaching-learning process.

Another study by **Ramaa (2019)** mentions that SLD was considered as a benchmark disability in recent times and hence the nature of support services provided to such children is very limited. Further there is a very limited number of professionals having expertise in the area of Learning Disability and Mathematics education. The lack of diagnostic tool availability in different languages also proves to be a major obstacle in this area. In India there is a common framework followed at the national level from grades 1 to 12^{th}. The study concluded by stating that more research is needed in this area.

1. **ICT in Mathematics Education - Post-Pandemic:** The following studies have revealed the beneficial use of ICT and E-learning as digital tools in the Post-Pandemic era especially in the area of mathematics education:

   - **Alabdulaziz (2021)** focused on finding out whether COVID-19 acted as a gateway for enhanced and increased digital learning in mathematical education. Further the study also explored the types of digital technologies used in Mathematics education in the Post-pandemic era. The study found that nearly 98% of the respondentsbelieved that the pandemic had indeed greatly expanded theuse of digital technologies in mathematic learning through use of different software and digital technologies in the form of Massive Open Online Courses (MOOCS) in maths, MathCAD among many other tools.

   - **Juan-Ignacio et al. (2021)** studied the teaching-learning in schools in times of COVID -19 lockdown and analysed the research findings from 1403 Spanish teachers who participated study. It was concluded that though most schools and teachers were making use of ICT technologies for teaching subjects such as science and mathematics, this usage was reproductive in nature instead of constructive.

   - **Viamonte et al. (2021)** studied the major changes in imparting mathematical curriculum owing to the compulsory digital shift during the academic year 2019-2020 under the influence of the COVID-19 pandemic. The study findings indicate that several practices have been reshaped and refined especially procedures of teaching, explanation and demonstration in mathematics, in light of the digital tool usage. The study highlighted the challenges faced by learners in the online mode such as missing face-to-face classes, lack of contact with peers and teachers, difficulty in adapting to changes in the assessment mode all of which led to a residual drop in student success when compared with previous semesters.

   - **Naidoo and Pillay (2021)** stated that educational institutions shifted to online mode in order to limit the spread of the virus, however issues linked to technology usage such as unequal access to data and devices, problems of internet connectivity make the transition challenging. The strength of ICT usage in educational transaction are linked with virtual communities, access to recordings of lectures, online collaboration which were observed as advantages of ICT usage.

   - **Srivastava (2021)** highlighted the available ICT tools such as audio-books, word processors, speech synthesizers, educational software, mobile devicesfor Children with Disabilities (CWDs). The study mentioned the use of ICT with special reference for Children with Intellectual Disability (CWID) for providing equal opportunities in teaching and learning along with leisure and recreation using review of relevant literature.

2. **ICT for Teaching Mathematics to SWSLD in Post Pandemic:**

   - **Chatzivasileiou and Drigas (2022)** analysed the role of metacognition in mathematics education for students with Specific Learning Disorder in Mathematics

(SLDM) through use of ICT tools. The study explored the role of computer games, mobile applications, educational software and robotics towards improvement of skills among the target group. It was found that usage of ICT especially in the current era helped to enhance the mathematical ability, metacognitive skillsalong with self-reflection, problem solving and self-regulation in students with SLDM.

IV. DISCUSSION AND CONCLUSION

The COVID-19 induced lockdown indeed has accelerated the pace of ICT usage and integration in the teaching-learning process, thereby fostering social inclusion through digital inclusion and supporting equity. There is need to identify gaps, issues and challenges in promoting digital inclusion for all bygovernments at both national and international level.The United Nations Department of Economic and Social Affairs (UNDESA) has identified and listed four key dimensions of an accessible, equitable and affordable ICT framework for the marginalized namely: ‘access, affordability, skills and awareness/relevance of online content’ (UNDESA Report, 2021).It is also noted that underdeveloped and developing countries often lack access to necessary technological infrastructure which includes devices, training and connectivity. It needs to be ensured that all students with or without disabilities need equal access to technology (Zervoudi, 2020).Consequently, the strong need to harness ICT for educational advancement especially in mathematics education is pertinent at all levels of the educational spectrum, ranging from preschools and primary schools with limited teaching resources to well-resourced colleges and vocational institutions, for learners with and without diverse needs.

1. **Major Findings:**

- ICT tools prove beneficial in teaching mathematics curricula through use of computer games, mobile apps and other educational software specially designed for this purpose.
- Usage of ICT and digital tools in mathematical training of SLD indicates a shift towards adoption of modern pedagogical approaches in contrast to traditional methodologies.
- The forced and compulsory shift from offline to online mode during the COVID-19 pandemic led to a drastic change in teaching, assessment and evaluation methods in mathematics education which impacted the students both socially and academically.
- There is stark dearth in research studies focusing on usage of ICT in mathematics education in the post-pandemic era for leaners with Specific Learning Disabilities.
- Government initiatives at the national level such as increased budgetary allocation for ICT development and promotion along with international measures undertaken by UNESCO and UNDESA foster positive encouragement and growth of ICT solutions towards fulfilment of SDGs and promotion of equity in education through digital inclusion.

2. **Recommendations:** The findings highlighted in this chapter clearly indicate the need for the following:

- Need for greater research focussing on mathematical education and training for CWSLD using ICT in the present digital age.
- Mathematics is a subject which is highly functional in nature and needed in everyday life. It is linked with adaptive skills which includes handling money, reading time, and other such essential areas. There is need to focus on novel behavioural, educational interventions involving ICT to teach mathematical curriculum to children with SLD.
- Need for skill training among teachers for imparting mathematical education to learners with SLD.
- Need for designing customized mathematical assessment, training and evaluation methods designed in accordance with unique needs for students with SLD.
- There is need for innovative measures in form of government acts and policies which will support growth of ICT based measures for promotion of equality in the classroom especially in STEM training for learners with disabilities with special reference to SWSLD.

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