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Analysis of Perceived Need for STEM-Based Approaches in Teaching Mathematics and Science to Students with Intellectual Disability

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Abstract

Ensuring students with intellectual disability participate in meaningful and active ways in learning remains an ongoing issue throughout inclusive education, especially when it comes to learning math and science. In order to address the issues of access, engagement and understanding, experiential and contextual learning is the type of teaching approach needed to meet the needs of students with intellectual disabilities. As an alternative to traditional methods of teaching, there has been a growing interest in STEM-based approaches that emphasize hands-on learning, problem solving and real-world application of concepts as a method to assist in creating inclusive learning opportunities. The purpose of this research study was to examine the perceived need by educators and professionals to utilize STEM-based approaches to increase learning accessibility for students with intellectual disabilities in inclusive classrooms at the elementary school level. A descriptive survey design was utilized to collect data from a sample of special educators and professionals who work with students with intellectual disabilities. A structured rating scale was used to collect the data through a questionnaire, specifically designed to focus on STEM education practices; perceived need for STEM strategies; and perceived benefits of utilizing STEM-based instruction. The results from the study indicated that the majority of the participants strongly felt that there is a need for STEM-based approaches to increase learning accessibility; increase engagement; improve problem-solving abilities and provide students with intellectual disabilities with real-life application of concepts. The study concluded that STEM-based approaches to instructional delivery are necessary to create stronger inclusive learning accessibility options for students with intellectual disabilities at the primary school level.

Keywords: *Need Analysis, STEM Education, Inclusive Education, Learning Accessibility, Intellectual Disability.*

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1. Introduction

STEM integration is not a one model of instruction but a variety of different interdisciplinary approaches that connect learning across content boundaries **(English, 2016; Herschbach, 2011)**. It can be very useful to think of integration inclusively since it allows concepts to be accessed and represented differently. As per Davison (1995), the fusion of science and mathematics curriculum can facilitate engagement in authentic and real-world learning, using various integration models. The same integration could be carried out in technological and engineering domains and would benefit learners with a different cognitive profile. Integrating STEM means moving away from teaching through lectures to building a learning environment around problems and experiences, which encourages learners to interact and work together (Breiner et al., 2012). Students who have special educational needs are supported in their teaching and learning approaches which promote engagement, hands-on behaviour, context-based learning and alternative pathways in learning and problem-solving. Integration within STEM education is still challenging to implement. Teachers commonly experiencing a barriers of the STEM curriculum integration have been cited as a lack of subject-matter knowledge and confidence, lack of time, inadequate professional development training and others **(Aldahmash et al., 2019; Herschbach, 2011; Hourigan et al., 2021; Ring et al., 2017)**.

Teachers today face significant challenges in their efforts to engage their learners in science and technology-based education. Furthermore, these issues become even more intense in an inclusive classroom wherein the teacher has to manage curricular demands while keeping in mind these learning differences. Evidence suggests that a good professional development (PD) program changes teachers' attitudes **(Aldahmash et al., 2019; Ring et al., 2017)**.

Mainstream classrooms face a lack of adaptation of educational activities and material to cater to the learning needs of students. The same approach and strategies are adopted for different students, ignoring the different needs of the students **(Bouck & Park, 2021)**. Students with intellectual disabilities face significant challenges in reintegration due to their conceptual limitations, which affect personalised learning approaches **(Kelley & Knowles, 2022)**. They are continuously excluded from the academic and social aspects of education due to the failure to adapt to their learning needs as they have been considered too difficult to adapt to the mainstream curriculum **(Li et al., 2023)**. Integrated STEM education is a good opportunity to strengthen inclusive education at special education since its interdisciplinary character allows students to cooperate in multi-varied activities **(Kelley & Knowles, 2022)**. This approach also creates the possibility of using new technologies in problem-based STEM learning so that students with intellectual disabilities could engage and grasp essential concepts **(Li et al., 2023)**.

2. Significance of the Study

The NCF (2005) provides for making education relevant, engaging and equipping the learner to make an effective contribution. Traditional instruction limited by established teaching approaches, using abstract explanations, may further constrain meaningful participation as instruction is textbook-based rather than context embedded **(Bouck & Park, 2021)**. STEM-based methods have been shown to be effective in creating hands-on inquiry-based investigations, minimize academic boundaries, and introduce real-world life systems as applications **(Kelley & Knowles, 2022; Li et al., 2023)**. Nonetheless, when evaluated based on barriers encountered to implement, systematic integration of STEM-based approached for students having inclusive education framework is very low **(Moon et al., 2021; Bustamante et al., 2022)**. These may

involve a gap between the curriculum and learning requirements, lack of teaching materials, and omissions in teacher preparation or training. As a result, the need analysis will help identify the other gaps and needs in current instructional practices to guide curriculum planning and teacher training and development of STEM-based instructional approaches for SwID.

Goals of This Study, The following objectives inspired the present study.

- The objective of the study was to find out the perceptions of special educators regarding STEM education for SwID. 2. The goal is to analyze the perceived need of STEM-based approaches in making inclusive education more accessible for SwID. 3. To learn about benefits perceived by special educators as well as SwID because of their STEM-based approaches

3. Methodology

3.1. Research Design

The research applied a descriptive survey design which facilitates the analysis of current practices and perceived needs associated with STEM-based instructional approaches for students with disabilities. **Creswell and Creswell (2018)** suggest that the descriptive survey design selected for this study is appropriate to collect the data from the teachers and professionals and get their perceptions, experiences and views on inclusive STEM education. The study involved special educators and professionals working with children with disabilities. A total of 133 respondents participated in the study. Purposive sampling technique was used to select the respondents of the study. Selection of respondents were done on the basis of their experience in teaching SwID in an inclusive or a special setup.

3.2. Method

The questionnaire was given to the selected respondents in both direct and online mode. Before the commencement of data collection, all subjects were made aware of the purpose of the study and consented. They were given the assurance that their replies will only be used for research. The respondents of the survey were provided adequate time to fill up the questionnaire. Further, during the data collection process, the privacy and confidentiality of the responses were maintained.

3.3. Data analytics

The data obtained through the questionnaire was evaluated using descriptive analysis. The responses were organized and explained on the basis of frequency and percentage to understand the reactions concerning STEM education, perceived need of STEM strategy, and perceived benefits of STEM based approach. The study aims to identify gaps in existing practices and strategies being used at the centres and the need for using STEM-based pedagogical approaches to make learning more accessible. Also, inclusive for SWID.

3.4. Results and Discussion

Analysis of the responses of the special educators and professionals collected was done through a descriptive interpretation to understand emerging trends of STEM education, perceived need of STEM-based strategies and the perceived benefits of STEM based approaches for SwID.The key objectives are represented using pie charts with descriptive narration and graphical presentation.

4. STEM Education for SwID

Responses relating to the STEM education indicate strong agreement among respondents that approaches based on STEM are suitable and relevant for SwID. Most of the respondents of the survey opined that diverse approaches in STEM education promote hands-on learning, problem-solving and greater participation and involvement of students The findings also suggested the beliefs of the respondents that selection of teaching methods and learning activities as per needs and abilities of SwID can be resorted to STEM. According to the findings, inclusive learning strategies and adaptations of the curriculum could help enable STEM education for these educators.

5. Need for STEM Tools

Study's strongest finding was a perceived need for STEM based strategies. According to data presented in figure 1, a vast majority of the responder pool (about 77 percent) were either in agreement or strongly in agreement that there

is a need for implementation of STEM based strategies for improvement of accessibility of learning and subject interest and involvement of students and for relating the concepts of mathematics and science to life for the students with disabilities, need for serious commitment at institutional, parental and community level for delivering effective academic instruction by teachers and training of students on effective use of assistive devices especially in class rooms for SwID. According to the responses, professional development opportunities, as well as access to STEM materials and institutional support are needed to implement STEM strategies in inclusive classrooms. The results clearly indicate that existing teaching practices require supplementation with STEM-based instructional approaches to address the diverse learning needs of SwID.

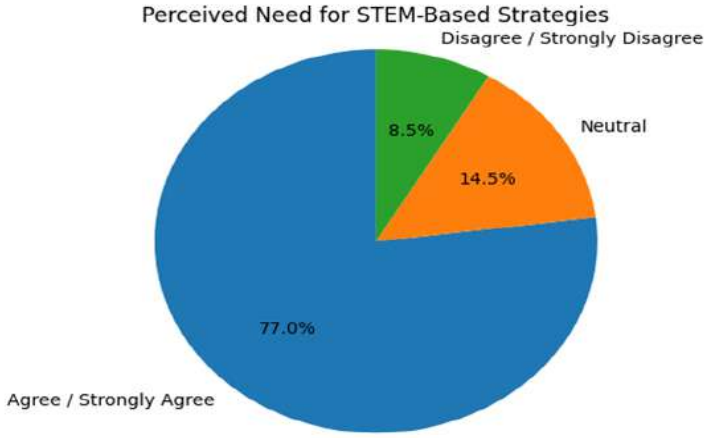

Figure 1
Perceived Need for STEM-Based Strategies

6. Perceived Benefits of STEM-Based Approaches

Responses related to perceived benefits revealed that STEM-based approaches were viewed as beneficial for both SwID and special educators. As shown in Figure 2, nearly 70% of respondents agreed or strongly agreed that STEM-based instruction enhances academic achievement, problem-solving skills, confidence, and self-esteem among SwID.

In addition, respondents perceived that STEM-based approaches support special educators by providing effective instructional strategies and opportunities for professional growth. The results also imply that STEM education enhances science and math learning accessibility and helps students with intellectual disabilities achieve better outcomes beyond school.

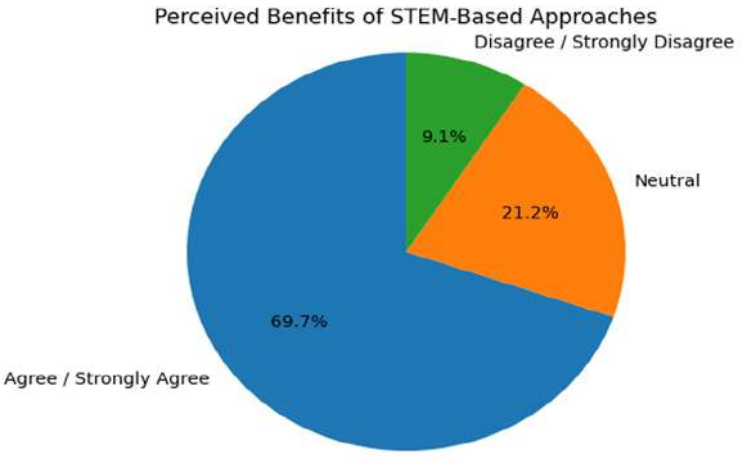

Figure 2
Perceived Benefits of STEM-Based Approaches

7. Overall Interpretation

The overall analysis of the data indicates a clear and significant perceived need for STEM-based instructional approaches in teaching mathematics and science to SwID. The strong agreement reflected in the pie-chart representations regarding both the need and benefits of STEM-based approaches underscores the importance of adopting inclusive, accessible, and innovative instructional practices in elementary education.

8. Discussion

This investigation examined the perceived need for STEM-based instructional approaches to enhance inclusive learning accessibility among SwID. The findings of this study offer valuable insights into educators' perceptions regarding STEM education in inclusive classrooms **(Margot & Kettler, 2019)**.

The results related to current teaching practices indicated that existing methods in mathematics and science were perceived as only moderately effective for SwID. The results from this study showed strong positive opinions regarding the suitability and feasibility of STEM based approaches for Students with Intellectual Disabilities (SwID). STEM instruction helps in providing an environment with hands-on learning opportunities and problem-solving approach while encouraging active participation in inclusive classrooms. These kinds of perceptions are reflected in the recent question papers of the quiz which show that the STEM approach of the lesson can be designed for better accessibility and active participation of distinct classes of learners with suitable modifications **(Israel et al., 2021; Kelley & Knowles, 2022)**. By encouraging contextualisation and experiential learning, these methods can reduce access challenges associated with abstract ideas. One of the main findings is the strong perceived need for STEM-based approaches. A large percentage of the respondents strongly agreed that one must use such methods to provide easy learning, higher motivation, and use the knowledge in real life. The results from recent studies which reveal that adequate teacher training and resources through institutionalising practices across the education system has growth potential for inclusive STEM education **(Moon et al., 2021; Li et al., 2023)**. The finding shows that the general practices in place are inadequate to meet the varying learning needs of SwID. Moreover, most educators strongly agreed on multiple benefits they saw as associated with improved academic achievement, problem-solving ability and confidence.

In addition, the professional competence and teaching efficacy of teachers increased. Overall, these findings suggest that interactive and learner-centred instructional frameworks are in high demand. Thus, STEM-based education is an important technique to develop inclusive educational practices.

9. Conclusion

STEM-based teaching methods are perceived as a strong need in bringing accessibility to SwID learning. The present study showed that despite the fact that elementary teachers implement inclusive education practices, specifically curricular practices in math and science were only rated as somewhat effective to meet learning needs of SwID. According to the findings, educators regarded hands-on, real-world learning experiences and curriculum adaptations as vital to SwID. But those adaptations are not done in practice. The respondents of this study had a very strong positive perception concerning the suitability/appropriateness and feasibility/practicality of STEM education. These findings suggest that the STEM-based approaches are considered appropriate and beneficial for SwID. This is especially true considering the supporting evidence of inclusive instructional practices. The perceived need for STEM-based instructional approaches is what largely remains critical. A large majority of respondents strongly feel the need for STEM-based strategies to create accessible learning, student engagement, and practical understanding of math and science concepts by SwID. In addition to this, both children and special educators feel they will be able to benefit from a STEM-based approach. In conclusion, the need analysis findings suggest that inclusive education of children with disabilities at elementary level requires use of STEM which is supported by multiple evidence.

10. Limitations and Suggestions for Future Research

The current study has several limitations which need to be highlighted while referring to the study. The researchers used a purposive sampling technique which according to the researchers limits the generalization of the findings. The sample size was also small which limits the findings to the sample itself. Hence, the generalisability potential of the study might be limited. Research may be done to study the effect of STEM-based approach using longitudinal studies. Further exploration of student performance and engagement, as well as functional learning outcomes, may be discussed for inclusive STEM education.

11. Conflict of Interest Statement

The authors declare that there are no conflicts of interest.

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