



Design Thinking as a Tool for Enhancing Creativity in STEM Education among Special Needs Teachers

Balamuralithara Balakrishnan¹

Sultan Idris Education University, Malaysia¹

Abstract

The recent trend in student enrollments indicates that individuals with disabilities are demonstrating a notable interest in pursuing STEM courses across numerous colleges and universities. This trend is substantiated by the findings in the previous studies, which indicate that students with disabilities exhibited a greater propensity to choose STEM majors in college compared to their peers without disabilities. This research seeks to investigate the effectiveness of a Design Thinking (DT) tool for educators specializing in special needs instruction within the domains of Science, Technology, Engineering, and Mathematics (STEM) at the secondary schools in Malaysia. Design Thinking (DT) offers an environment conducive to innovative thought, allowing educators to employ suitable tools to enhance their creative thinking abilities. Educators who implemented design thinking in their teaching exhibited heightened creativity and innovation, fostering a supportive learning atmosphere within the classroom. This environment is crucial for effectively instructing students, particularly those in special needs education, in STEM subjects. In this study, the influence of the DT tool was examined within the framework of lesson plan formulation for STEM disciplines and in the enhancement of creative competencies among educators in special education. Data were collected via open-ended interviews with a group of special education teachers chosen from participants of a design thinking workshop conducted by the researcher. The findings indicated that the DT tool enabled educators to create and implement appropriate STEM teaching activities, thereby enhancing the learning experience for students with disabilities in STEM-related subjects. Furthermore, the DT tool enabled educators to fully express their creative abilities within the instructional framework. The findings suggest that the application of the DT tool may facilitate the emergence of a novel pedagogical framework for STEM disciplines within special needs education, while also fostering innovative competencies among educators.

Keywords: *STEM Education, Design Thinking, Creative Teaching, Special Needs Education*

1. Introduction

STEM, which stands for Science, Technology, Engineering, and Mathematics, is a popular term in education. Deliberations among educators and intellectuals on STEM education have intensified, reflecting stakeholder concerns in this field. Teaching and learning STEM disciplines worldwide face numerous challenges. The decline in student enrollment in these subjects is a major concern. A favorable trend in student enrollments indicates a growing interest in STEM courses among students with disabilities at various institutions and universities [1]. This study discusses special needs education for students with various disabilities, including physical, sensory, cognitive, developmental, learning, intellectual, emotional, and behavioral issues.

Students with disabilities should have equitable access to STEM disciplines, enabling them to pursue STEM-related jobs like engineering that align with their skills. To prepare students with disabilities for STEM careers, it is important to foster their enthusiasm in STEM disciplines and personalize the learning approach to their needs. Research has shown that experiencing and understanding the subject matter significantly impact students with disabilities' interest in STEM education. Students with disabilities may fail to grasp and enjoy mathematics and scientific courses due to their heavy reliance on textbooks [3]. [3] also argued that children with impairments were not provided with appropriate STEM instruction resources. Special education teachers are crucial in creating and executing effective pedagogies to foster a profound understanding of STEM disciplines.

According to [4], teachers should focus on (1) understanding creativity, (2) fostering creative traits, and (3) practicing creative abilities. Education should emphasize exposing educators to basic creativity



and encouraging them to practice creative talents in the classroom. [4] also emphasized that instructors with creative expertise are likely to include creativity in their teaching. Stakeholders must foster a climate that allows instructors to incorporate creativity into their teaching.

In Malaysia, all schools must follow the same special education curriculum approved by the Ministry of Education, which is equivalent to mainstream education. Teachers must address the difficulty of teaching children with impairments in STEM courses using the same curriculum as all other pupils. STEM educators must work more to establish a proper learning environment for pupils. Both teachers and students will face many challenges that make such endeavors difficult. According to [3], teachers typically lack the necessary skills and knowledge to fully engage students with impairments in STEM classrooms.

Teachers must possess adequate pedagogical skills to adjust their instruction to the needs and requirements of students with impairments. Customizing teaching approaches is challenging, but with innovation, they can create effective pedagogies that improve STEM topic learning [5]. Creative teaching methods are crucial for STEM classrooms with students with disabilities. Engaging and relevant STEM instruction enhances comprehension and fosters enthusiasm in the subject. Thus, special needs teachers need to prioritize developing new teaching strategies for STEM courses. This issue has multiple solutions, including teachers identifying and using relevant learning materials to enhance their teaching techniques creatively.

In the creative performance model, Amabile [6] identified three components of individual creativity: domain-relevant skills, creativity-relevant skills, and task motivation. The first and second components of the creative performance model emphasize the need to acquire information and skills during training and formal and informal education to generate original ideas [6]. This study highlights the importance of providing instructors with the appropriate tools to develop creative thinking abilities and unleash their creativity.

The use of Design Thinking (DT) allows educators to further develop their creative thinking skills using appropriate resources [7]. DT encourages users to think like designers and apply a human-centric approach to solve problems effectively [7, 8]. According to [8], instructors that use DT in their teaching are more creative and imaginative, creating a suitable learning environment for STEM courses, especially for special needs students. To engage students with disabilities in STEM education, teachers must be creative in class preparation and delivery to fit their needs. Teachers in special education should be familiar with DT tools to design effective teaching materials and arrange engaging classroom activities.

The “Design Thinking Workshop” was held in Perak, Malaysia, to introduce secondary-level special education teachers to the DT tool. The course aimed to enhance special education teachers' creative thinking skills, enabling them to create a more engaging STEM teaching environment. The goal is for special education teachers to generate innovative lesson plans. The researcher investigated the usefulness of DT in supporting teachers in their teaching. This study can aid special education teachers in using the DT tool to teach STEM courses. This study provides helpful details about the effectiveness of DT as a tool for special education teachers to enhance their STEM topic teaching practices, despite its limited research.

2. Design Thinking Workshop

Forty (40) special education teachers from Perak, Malaysia, participated in the DT program, which focused on STEM teaching for special needs. This two-day workshop introduced instructors to DT tools. This workshop included a creative problem-solving strategy using this tool. Participants received hands-on training on the DT process in the classroom. The program aimed to develop creative skills in teachers for building STEM pedagogy in special education. The session also aimed to encourage creativity among participants. The workshop was organized into three primary slots: 1. Creative STEM Teaching in Special Education 2. Design Thinking 3. Idea pitching. Participants examined STEM teaching and learning concerns for special education in this workshop. After the training session, participants utilized the Design Thinking (DT) tool to create solutions for the identified challenges. This session used the Stanford *d.school* module, which emphasizes user needs, ideation, and teamwork



[9]. Teachers shared new ideas for lesson plans and activities to enhance STEM education for special needs students during the idea pitching session.

3. Methodology

The researchers conducted a study over a duration of twelve weeks to investigate the influence of the DT tool on the formulation of effective lesson plans and the enhancement of creative skills among participants. The research question formulated to guide the study is as follows: Does DT facilitate the development of lesson designs for STEM classrooms catering to special needs?

A stratified sampling method was utilized to select twelve teachers from the forty participants of the DT workshop. The twelve educators are in schools located in urban areas. The researchers secured consent from the respondents for the interviews. The selection criteria for the teachers to be interviewed are as follows: (1) each selected teacher must represent one of the twelve districts in Perak, Malaysia, and (2) each selected teacher must have more than five years of experience teaching STEM subjects to students with disabilities. The interviews were conducted following a ten-week period of the workshop. Researchers could not analyze lesson plans, classroom teaching observations, and exhibited pedagogical innovations because the Ministry of Education, Malaysia, did not grant consent. Furthermore, the study primarily focused on the use of DT in the teaching process among special education teachers. In the open-ended interview, teachers were asked how the DT tool learned in the workshop has assisted them in the teaching process for students with disabilities.

The interview question received validation from two experts in special needs STEM education, each possessing ten years of experience. The interviewees were provided sufficient time to articulate their opinions without undue pressure during the interview sessions. Probing questions were employed to enhance clarity and elicit responses that accurately represent the views of respondents. The probing questions were indirect and aligned with the research questions of the study.

4. Results And Discussion

After the interviews, the transcripts were reviewed to identify emergent themes. Researchers manually employed open-coding to identify and underline key themes in interview transcripts.

Furthermore, a validation process was conducted on these transcripts in accordance with the guidelines established by Merriam (1998), with the subsequent steps being as follows:

1. Reviewing the interview transcripts with the participants to obtain their consent.
2. Reevaluating the interview transcripts with two professionals possessing over a decade of expertise in the field of special needs education.

The third step involved confirming that the interview outcomes aligned with the research parameters and were coherent with the study's research inquiries.

Interview data saturation occurred at the fifth responder. Themes and respondent replies are summarized in Table 1. Interview data indicate that the DT tool positively impacted interviewees' teaching process for STEM subjects.

Table 1: Themes and Responses for Interview Question

Theme	Responses Example
a. Prioritizing Students	<p>Respondent B:</p> <p>"I began to consider and prioritize my students' needs prior to drafting my lesson plan." Given my responsibility to instruct students with impairments, design thinking may undoubtedly enhance the efficacy of my STEM teachings by addressing each student's unique needs.</p>



	<p>Respondent E:</p> <p>"DT can undoubtedly assist me in formulating suitable lesson plans for my students with disabilities." Since its initial phase emphasizes empathy, design thinking urges me to acknowledge students' needs in order to develop effective STEM lesson plans, a thought I had not previously entertained before attending the design thinking workshop. I exclusively utilized the ministry's curriculum to build my lesson plans, which inherently include certain downsides and limits, particularly in instructing kids with impairments.</p>
<p>b. Impactful STEM Lesson</p>	<p>Respondent A:</p> <p>"After the DT workshop, I believe I can create my STEM lesson plans to be more meaningful and creative for my students, as I will always consider their specific learning needs and requirements in the design of such plans."</p> <p>Respondent C:</p> <p>"Students with disabilities are different. Students with disabilities learn STEM subjects differently than mainstream students do. The DT workshop has shown me a good path to planning and designing meaningful STEM lessons for such children in the classroom."</p>
<p>c. Confidence to be Creative</p>	<p>Respondent J:</p> <p>"Using the DT tool has given me the confidence to think creatively in my classroom. During teaching, I could see that student engagement was better compared to that of previous teachings before I was exposed to the use of the DT tool. During my training as a teacher, there was not much exposure to how to be creative. Likewise, after becoming a trained teacher, I never had the opportunity to learn the DT tool."</p> <p>Respondent G:</p> <p>"Overall, my confidence level in being creative has improved after acquiring the knowledge and skills from the DT workshop. With excellent creative skills, I can innovate my teaching in my classroom."</p>

The study has revealed three important themes: (i) (i) prioritizing students, (ii) impactful STEM lessons, and (iii) confidence to be creative. The use of the DT tool has impacted the interviewees' methods in developing STEM lesson plans and their instructional strategies for children with special needs. The study respondents successfully shifted their thinking style from that of a teacher to that of a designer. Simultaneously, teachers adopted a more emphatic teaching approach, focusing on the needs of students with disabilities while developing STEM lesson plans utilizing the DT tool, which could enhance meaningful learning experiences for these students. The themes related to creative confidence and innovative solutions demonstrate that the design thinking tool facilitated teachers in acquiring and applying the appropriate processes for creativity in their classroom teaching activities.



The findings align with [10], who assert that the DT tool has enabled teachers to adopt a designer's mindset and approach. The interview results indicate that most interviewees perceived themselves as designers in the planning and development of lesson plans for these students. This revelation indicates that DT has introduced a new dimension to the thinking and actions of these teachers.

This study demonstrates that special education teachers can utilize the DT tool to cultivate creative skills applicable in their teaching process. DT is essential for teachers to effectively address challenging demands and resolve issues in STEM education. By adhering to the five steps of design thinking, educators can cultivate a designer's mindset, facilitating the ability to think and act as designers.

This transformation enhances their empathy towards students' needs and boosts their confidence in developing innovative teaching activities for STEM subjects. Thus, by implementing the aforementioned elements, an environment can be established that enables students with disabilities to actively participate in meaningful learning in STEM subjects, facilitating better comprehension of the material and fostering a sustained interest in STEM-related careers.

5. Conclusions

Teachers in special needs education must prioritize their attention and instruction based on the diverse needs of students with disabilities. To effectively execute this task, teachers must demonstrate creativity in the design, development, and implementation of their instruction. In summary, they must possess strong creative skills to engage in such an endeavor. The application of the DT tool facilitates a novel approach to creative teaching within the realm of special education.

DT has introduced an innovative approach to analyzing and addressing challenges in STEM education, particularly for students with disabilities. We can redesign existing teaching models for special needs education by taking into account the diverse learning needs and disabilities of these students.

This study demonstrates that DT serves as a significant tool for enhancing creativity among STEM teachers in the development of innovative lesson plans, which, when effectively executed, can facilitate a meaningful and impactful learning experience for students. The application of the DT tool enables special education teachers to engage in creative and innovative practices, facilitating the development of effective and meaningful STEM teaching activities. In summary, DT can enhance their capabilities as STEM educators, enabling them to teach STEM subjects to students with disabilities in innovative ways.

REFERENCES

- [1] Borrego, M., Chasen, A., Chapman Tripp, H., Landgren, E., & Koolman, E. (2025). A scoping review on US undergraduate students with disabilities in STEM courses and STEM majors. *International Journal of STEM Education*, 12(1), 2.
- [2] Chasen, A., Borrego, M., Koolman, E., Landgren, E., & Chapman Tripp, H. (2025). A systematic review of differences for disabled students in STEM versus other disciplinary undergraduate settings. *Journal of Engineering Education*, 114(1), e20627.
- [3] Kahn, S. (2023). Special needs and talents in science learning. In *Handbook of Research on Science Education* (pp. 325-358). Routledge.
- [4] Revenko, I., Hlianenko, K., Sosnova, M., Vlasenko, R., & Kolodina, L. (2024). The exploration of pedagogical approaches and methods that are designed to stimulate the creative thinking of students. *Cadernos de Educação Tecnologia e Sociedade*, 17(se1), 137-146.
- [5] Klimaitis, C. C., & Mullen, C. A. (2021). Including K-12 Students with Disabilities in STEM Education and Planning for Inclusion. *Educational Planning*, 28(2), 27-43.
- [6] Amabile, T. M. (2018). *Creativity in context: Update to the social psychology of creativity*. Routledge.
- [7] Muneer, S., Santhosh, M., Parangusan, H., & Bhadra, J. (2025). A meta-analysis to explore the role of design thinking in enhancing creativity as learning outcomes in STEM education. *International Journal of Technology and Design Education*, 1-31.



- [8] Wingard, A., Kijima, R., Yang-Yoshihara, M., & Sun, K. (2022). A design thinking approach to developing girls' creative self-efficacy in STEM. *Thinking Skills and Creativity*, 46, 101140.
- [9] Tan, H., Kidman, G., Gesthuizen, R., & Mangao, D. D. (2025). Integrating Design Thinking in STE A+ M Education: The PaDL Framework for Planning and Learning. In *Knowledge Generation in STEM and STEAM Education: Integrative Thinking and Agency* (pp. 259-295). Cham: Springer Nature Switzerland.
- [10] Bosch, N., Härkki, T., & Seitamaa-Hakkarainen, P. (2025). Teachers as reflective learning experience designers: Bringing design thinking into school-based design and maker education. *International Journal of Child-Computer Interaction*, 43, 100695.