



## Comparative analysis of inclusive education policies in STEM and general education

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### Abstract

This research conducts a comparative analysis of inclusive education policies in STEM and general education, examining key components and identifying strengths and weaknesses. In STEM, proactive measures address underrepresentation, fostering hands-on learning and integrating adaptive technologies. General education policies adopt a holistic approach, prioritizing inclusivity across diverse learning environments. Identified gaps include variations in resource distribution and teacher training effectiveness. Implications call for targeted interventions to enhance inclusivity, while recommendations emphasize policy revisions and collaborative initiatives. A cross-disciplinary approach is urged for policymakers to draw upon the strengths of STEM and general education, fostering a more cohesive and equitable educational landscape for diverse student populations.

**Keywords:** Inclusive education; STEM education; Educational policy; Comparative analysis; Equity and diversity

### 1. Introduction

In recent years, inclusive education has emerged as a pivotal focus in educational discourse, reflecting a global commitment to providing equitable learning opportunities for all students, irrespective of their diverse backgrounds and abilities. The crux of inclusive education lies in fostering an environment where every learner feels valued, supported, and included in the educational process. Inclusive education transcends the traditional boundaries of exclusion, striving to accommodate the needs of students with varying abilities, learning styles, and socio-cultural backgrounds (Norwich, 2013; Schuelka & Carrington, 2021).

Inclusive education encompasses a pedagogical approach to integrating students with disabilities, special educational needs, or diverse cultural backgrounds into mainstream educational settings (Armstrong, 2015; Suleymanov, 2015; Winter & O'Raw, 2010). The overarching goal is to break down barriers that hinder access to education and promote a more inclusive society. Stemming from principles of social justice and equality, inclusive education not only focuses on addressing the needs of students with disabilities but also acknowledges the importance of accommodating all forms of diversity within the educational landscape. Inclusive education is crucial in Science, Technology, Engineering, and Mathematics (STEM) and general education. With their inherent complexity, STEM disciplines often challenge students with diverse learning needs. Fostering inclusivity in STEM education ensures equal opportunities for all. It taps into a broader talent pool, potentially unlocking innovative solutions to global challenges. Moreover, inclusive general education sets the foundation for a holistic and supportive learning environment, influencing students' academic and social development beyond specific subject areas (Mitchell & Sutherland, 2020).

However, despite the increasing recognition of inclusive education, disparities persist in formulating and implementing inclusive education policies. These disparities extend across various dimensions, encompassing variations in resource allocation, support services, and teacher training programs. The consequences of these discrepancies are profound, affecting the educational experiences of diverse student populations (Neupane, 2020; Powell, 2015). Students with

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disabilities, those from marginalized communities, and those with unique learning needs often face barriers that impede their academic success and hinder their overall development within educational settings (Banks, 2014; Trainor, Lindstrom, Simon-Burroughs, Martin, & Sorrells, 2008).

The impact of unequal access to inclusive education policies is particularly pronounced among diverse student populations. Students who encounter barriers to inclusion may experience lower academic achievement, diminished self-esteem, and a sense of alienation within the educational community. The lack of inclusivity may also perpetuate societal stereotypes and reinforce existing inequalities (Juvonen, Lessard, Rastogi, Schacter, & Smith, 2019). Therefore, understanding and addressing the disparities in inclusive education policies is imperative for fostering a truly inclusive educational system that caters to the needs of all learners. To confront these challenges and contribute to the advancement of inclusive education, this research endeavours to achieve the following objectives: to scrutinize the specific policies and practices in inclusive education within STEM disciplines and compare them with those in general education and to discern the strengths and weaknesses inherent in the inclusive education policies in both STEM and general education. By pinpointing areas of success and areas requiring improvement, the research seeks to contribute valuable recommendations for policymakers, educators, and stakeholders to enhance the inclusivity of educational practices.

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## **2. Literature Review**

### **2.1. Inclusive Education in STEM**

Inclusive education in STEM encompasses the deliberate integration of students with diverse learning needs into mainstream STEM classrooms. The goal is to provide an environment where learners, including those with disabilities or unique learning styles, can actively engage with STEM subjects. The scope of inclusive STEM education extends beyond the physical presence of students; it involves adapting curricula, employing varied teaching methodologies, and fostering a supportive learning community that addresses the diverse needs of learners in STEM disciplines.

Inclusive STEM education presents both challenges and opportunities. Challenges include the need for accessible learning resources, adaptive technologies, and trained educators capable of accommodating diverse learning styles. Opportunities arise in the form of fostering innovation and creativity through the integration of diverse perspectives in problem-solving. Moreover, inclusive STEM education can contribute to addressing the underrepresentation of certain groups, such as women and individuals with disabilities, in STEM fields by creating pathways for their active participation and success (Bellman, Burgstahler, & Chudler, 2018; Lynch et al., 2018; National Academies of Sciences & Medicine, 2020). Several studies have delved into the realm of inclusive STEM education, exploring various aspects such as effective teaching strategies, the impact of inclusive practices on student achievement, and the role of technology in facilitating inclusive learning environments (Clements, Vinh, Lim, & Sarama, 2021; Hughes, Schellinger, Billington, Britsch, & Santiago, 2020; Johnson, 2019; Nguyen, Nguyen, & Tran, 2020). Previous research has highlighted the importance of early interventions, teacher professional development, and collaborative approaches in promoting inclusivity in STEM education (Dede, Eisenkraft, Frumin, & Hartley, 2016; Hsu & Fang, 2019; Margot & Kettler, 2019). The synthesis of this body of research serves as a foundation for understanding the current landscape and informing future directions in inclusive STEM education.

### **2.2. Inclusive Education in General Education**

Inclusive education in general settings embraces a philosophy that supports the full participation of all students, regardless of their abilities, backgrounds, or differences, in the same educational activities and environments (Allan, 2007; Dare & Nowicki, 2018). The core principle is to create an inclusive school culture that values diversity, promotes equity, and actively involves all students in learning. In general education, inclusive practices extend beyond accommodating students with disabilities and encompass a broader commitment to recognizing and celebrating all forms of diversity among students. While the principles of inclusive education are universal, there are challenges specific to general education. These challenges include the need for differentiated instruction to cater to diverse learning styles, creating inclusive classroom environments that support various abilities, and providing adequate support services for students with unique needs (Roche, 2016; Udvari-Solner, Villa, & Thousand, 2005). The effective implementation of inclusive practices in general education requires a systemic approach involving collaboration among educators, administrators, and support staff to address these challenges comprehensively.

Numerous success stories and best practices have emerged from schools and educational institutions successfully implementing inclusive education in general settings. These stories often highlight the positive impact on student outcomes, improved social cohesion, and the developing of a more inclusive school culture. Best practices encompass

creating flexible learning environments, promoting student collaboration, and offering professional development opportunities for educators. These success stories serve as models for other institutions seeking to enhance their inclusive education practices in general settings (Beldarrain, 2006; Danielson, 2007; Kennedy, 2010).

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### **3. Theoretical Framework**

The development and implementation of inclusive education policies are guided by various theoretical frameworks that emphasize the principles of equity, diversity, and accessibility. Inclusive education policy models often draw from international declarations and conventions, such as the Salamanca Statement and the Convention on the Rights of Persons with Disabilities (CRPD). These models advocate for policies beyond physical inclusion, emphasizing creating environments where all students can actively participate and achieve their full potential (Beckman, Abera, Sabella, Podzimek, & Joseph, 2016; Palmer, 2013). The shift from segregated to inclusive education is underscored by recognizing that diversity is an inherent strength, and educational policies should reflect this inclusivity.

Inclusive education policy models commonly incorporate universal design for learning (UDL), differentiation, and individualized support mechanisms. UDL, for instance, advocates for designing curriculum and instructional methods that cater to diverse learning styles and needs. Similarly, differentiation strategies aim to provide varied approaches to content delivery, assessment, and support, ensuring that every student can engage meaningfully in the learning process regardless of their abilities (Navaitienė & Stasiūnaitienė, 2021; Sanger, 2020; Zhang, 2020).

Applying inclusive education policy models to STEM and general education involves tailoring these frameworks to each domain's specific characteristics and challenges. In the context of STEM education, inclusive policies should address not only the accessibility of content but also the unique challenges posed by the practical and theoretical aspects of science, technology, engineering, and mathematics. This may involve incorporating assistive technologies, flexible assessment methods, and providing adequate support services to ensure students with diverse learning needs can actively participate and succeed in STEM disciplines. Similarly, applying inclusive education policy models in general education requires a comprehensive approach beyond accommodating students with disabilities (Gilmour, 2018; Jiménez, Graf, & Rose, 2007; Mitchell, 2015). It involves creating a culture of inclusivity that recognizes and celebrates diversity in all its forms. Policies should be designed to promote collaboration among students, provide professional development opportunities for educators, and establish support structures that address the multifaceted needs of a diverse student population (McLaughlin & Talbert, 2006; Parkhouse, Lu, & Massaro, 2019).

The intersectionality of inclusive education policy frameworks in STEM and general education lies in their commitment to dismantling barriers and fostering environments where every learner can thrive. While the specific challenges may vary between STEM and general education, the overarching principles of equity, accessibility, and diversity remain central in guiding the formulation and implementation of inclusive education policies. This theoretical framework provides the conceptual underpinning for the subsequent comparative analysis of inclusive education policies in STEM and general education.

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## **4. Comparative Analysis Framework**

### **4.1. Key Components of Inclusive Education Policies**

One of the fundamental components of inclusive education policies is ensuring equitable access and enrollment for all students, irrespective of their diverse backgrounds and learning needs (Mitchell, 2018; Peters, 2004). Policies should address barriers that may hinder enrollment, including physical accessibility, socio-economic factors, and discrimination. In the comparative analysis, examining the effectiveness of access and enrollment strategies in STEM and general education settings will shed light on the inclusivity of educational opportunities.

Inclusive education policies must encompass inclusive curricula and instructional strategies that cater to diverse learning styles and abilities. In STEM and general education, the analysis will focus on the extent to which curricular content is adaptable, the incorporation of universal design principles, and the provision of varied instructional methods. The goal is to identify policies that foster an inclusive learning environment where every student can engage with the curriculum effectively. Teacher training and professional development are pivotal in implementing inclusive education policies (King-Sears, 1997; Salend, 2010). The analysis will examine the adequacy and relevance of training programs for STEM and general education educators. It will assess whether teachers receive the necessary tools and knowledge to create inclusive classrooms, accommodate diverse needs, and foster a supportive learning environment.

Effective inclusive education policies should provide a range of support services and accommodations to address the specific needs of diverse student populations. This includes assistive technologies, individualized learning plans, and additional learning resources (Bryant, Bryant, & Smith, 2019; Hayes & Bulat, 2017; Hitchcock & Stahl, 2003). The comparative analysis will evaluate the availability and effectiveness of support services and accommodations in STEM and general education, aiming to identify gaps or areas for improvement. Inclusive education policies need to establish fair and inclusive evaluation and assessment practices. The analysis will scrutinize assessment methods to ensure they accommodate diverse learning styles and provide accurate measures of student achievement. Additionally, the evaluation of policies will assess whether assessment practices contribute to a supportive learning environment that encourages the participation of all students, regardless of their abilities (Lai, 2011; Webster-Stratton, Jamila Reid, & Stoolmiller, 2008).

#### **4.2. Analytical Tools**

To facilitate a rigorous comparative analysis, specific metrics and indicators are essential. Comparative metrics may include enrollment, academic achievement data, graduation, and participation in extracurricular activities. Indicators may encompass the presence of inclusive curricular materials, teacher training hours, and the availability of support services (King, McQuarrie, & Brigham, 2021; Scott, Bailey, & Kienzl, 2006). These quantitative measures will provide a basis for comparing the impact and effectiveness of inclusive education policies in both STEM and general education.

A well-defined analytical framework is crucial for organizing and interpreting the comparative data. This framework will structure the analysis by categorizing information based on the key components of inclusive education policies (Kiger & Varpio, 2020). It will guide the comparison of policies, enabling a systematic evaluation of strengths and weaknesses in access, curriculum, teacher training, support services, and assessment practices. The framework will also consider contextual factors that may influence the implementation of policies, providing a nuanced understanding of the comparative landscape.

The Comparative Analysis Framework outlined above is the methodological structure for evaluating and contrasting inclusive STEM and general education policies. The comparative analysis aims to uncover insights that enhance inclusive education practices across diverse educational domains by systematically examining key components and employing specific analytical tools.

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## **5. Comparative Analysis Results**

### **5.1. Overview of STEM Inclusive Education Policies**

The examination of STEM-inclusive education policies reveals a multifaceted landscape. Access and enrollment efforts are often geared towards addressing the underrepresentation of certain groups, with initiatives to increase participation from women and individuals with disabilities. The analysis of curriculum and instructional strategies in STEM highlights the integration of hands-on, experiential learning and the incorporation of diverse role models in STEM fields (Abu Khurma, Al Darayseh, & Alramamneh, 2022; Ghanbari, 2015; Kyere, 2017). Teacher training and professional development programs equip educators with the skills to implement inclusive pedagogies, including using adaptive technologies. Support services and accommodations often emphasize the provision of specialized labs, assistive technologies, and mentorship programs (Jeannis et al., 2018; Sukhai et al., 2014). Evaluation and assessment practices in STEM education tend to adopt a holistic approach, acknowledging diverse forms of student achievement beyond traditional assessments.

The strengths of STEM inclusive education policies lie in their proactive approach to addressing underrepresentation, fostering hands-on learning experiences, and integrating adaptive technologies. However, weaknesses may include challenges in ensuring uniform access to specialized resources and the need for further refinement in assessment practices. Additionally, the effectiveness of teacher training programs may vary, impacting the consistent implementation of inclusive practices across STEM disciplines (Henderson, Beach, & Finkelstein, 2011; Shernoff, Sinha, Bressler, & Ginsburg, 2017).

### **5.2. Overview of General Education Inclusive Policies**

General education inclusive policies exhibit a comprehensive approach to inclusion, aiming to create a welcoming environment for all students. Access and enrollment strategies prioritize eliminating barriers related to socio-economic status, ethnicity, and diverse learning needs. Curricula and instructional strategies emphasize differentiation, ensuring content is adaptable to varying learning styles. Teacher training and professional development programs concentrate on building inclusive teaching practices, promoting diversity awareness, and fostering cultural competence. Support

services and accommodations encompass various resources, from accessible facilities to counselling services. Evaluation and assessment practices prioritize fairness, incorporating diverse methods to gauge student achievement (Mohammad Mosadeghrad, 2013; Wong & Solomon, 2002).

The strengths of general education inclusive policies lie in their holistic approach to inclusivity, addressing a wide array of student needs and promoting diversity awareness. However, challenges may arise in ensuring consistent implementation across diverse educational settings, and there may be room for improvement in providing specialized support services. Additionally, the effectiveness of teacher training programs may require ongoing assessment and enhancement to meet evolving needs.

### **5.3. Cross-Comparison**

The cross-comparison of inclusive STEM and general education policies reveals commonalities and differences. Shared strengths include a commitment to diversity, efforts to address barriers, and promoting inclusive instructional practices. However, differences may emerge in the specific challenges faced by each domain. STEM education may grapple with the need for specialized resources. In contrast, general education may focus on achieving uniform inclusivity across diverse learning environments.

Despite the strengths observed in STEM and general education inclusive policies, areas for improvement can be identified. Enhancements in access and enrollment strategies, particularly ensuring equitable access to specialized resources, could be a focal point. Refining teacher training programs to address evolving needs and fostering collaboration between STEM and general education could further strengthen inclusive practices (Lynch et al., 2018; Rock et al., 2016). The cross-comparison underscores the importance of an integrated and collaborative approach to inclusive education, recognizing each educational domain's unique challenges and strengths.

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## **6. Implications and Recommendations**

### **6.1. Implications for Policy and Practice**

The comparative analysis of STEM and general education inclusive policies underscores the need for targeted efforts to address identified gaps. These may include discrepancies in the provision of specialized resources, variations in teacher training effectiveness, and challenges in achieving uniform inclusivity across diverse educational settings. Policymakers and practitioners should prioritize addressing these gaps through targeted interventions, allocating resources where needed, and ensuring a consistent and inclusive implementation of policies across different educational domains.

The analysis highlights opportunities for enhancing inclusivity in both STEM and general education. Policymakers and practitioners can draw upon successful strategies identified in each domain, such as promoting hands-on learning experiences in STEM or fostering cultural competence in general education. By incorporating these effective practices into a broader framework, education systems can work towards creating environments that cater to the diverse needs of all students. This approach requires a holistic understanding of the unique challenges and strengths within STEM and general education, fostering a collaborative and integrated approach to inclusivity.

### **6.2. Recommendations for Policymakers**

Policymakers should consider revising and refining existing inclusive education policies to address the specific challenges identified in both STEM and general education. This may involve ensuring a more equitable distribution of resources, refining teacher training programs to meet evolving needs, and establishing more precise guidelines for implementing inclusive practices. Periodic reviews and revisions of policies will be essential to keep pace with the dynamic nature of educational environments and the evolving needs of diverse student populations.

To foster a more inclusive educational landscape, policymakers should promote collaborative initiatives and partnerships between STEM and general education. Cross-disciplinary collaborations can lead to the development of comprehensive and integrated inclusive education policies that draw upon the strengths of both domains. Collaboration can extend to joint professional development programs for educators, shared resources, and collaborative research efforts. By breaking down silos and promoting collaboration, policymakers can create a more cohesive and inclusive educational system that benefits all students.

## 7. Conclusion

In conclusion, the comparative analysis of inclusive education policies in STEM and general education reveals a nuanced landscape marked by both strengths and areas for improvement. The study underscores the importance of addressing identified gaps in access, curriculum, teacher training, support services, and assessment practices. By acknowledging each domain's unique challenges and strengths, policymakers and practitioners can work collaboratively to refine existing policies, ensuring they are inclusive, equitable, and adaptable to the evolving needs of diverse student populations.

The implications for policy and practice emphasize the need for targeted interventions to bridge identified gaps and enhance inclusivity in STEM and general education. Recognizing the commonalities and differences between the two domains provides an opportunity for a more integrated and collaborative approach to inclusive education. Policymakers are encouraged to revise and improve existing policies, fostering an environment that supports the diverse learning needs of all students.

Moreover, the recommendations suggest the importance of ongoing policy revisions, improvements, and collaborative initiatives to create a cohesive educational system. By breaking down silos and promoting cross-disciplinary partnerships, policymakers can harness the strengths of both STEM and general education to develop more comprehensive and effective inclusive education policies. In doing so, education systems can aspire to provide a truly inclusive and equitable learning environment for all students, irrespective of their diverse backgrounds and abilities.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest exists among the Authors.

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