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DIFFERENTIATED LEARNING STRATEGIES TO IMPROVE THE INTERPERSONAL SKILLS OF STUDENTS WITH DISABILITIES IN SCIENCE LEARNING

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Abstract

This study aims to analyze the role of differentiated learning in developing the interpersonal skills of students with disabilities through Natural Science (IPA) learning in an inclusive educational environment. Interpersonal skills, such as social participation, communication, collaboration, and self-confidence, are important competencies that support the academic and social success of students with disabilities, but are often not optimally developed in inclusive practices. This study used a Systematic Literature Review (SLR) design with a descriptive qualitative approach. Data were obtained from reputable national and international journal articles published between 2021 and 2025 and analyzed using thematic analysis techniques. The synthesis results indicate that differentiated learning—especially in the aspect of process differentiation—plays a significant role in improving the quality of social interactions of students with disabilities through flexible grouping, collaborative role assignments, and adjustments to learning activities according to students' readiness and learning profiles. Inquiry-based and collaborative IPA learning has proven to be an effective social space for inclusively training students' communication, cooperation, and self-confidence. These findings confirm that differentiated learning functions not only as an academic strategy but also as a social learning mechanism that supports the development of interpersonal skills in students with disabilities. The implications of this research emphasize the importance of deliberate instructional

design, teacher competency in differentiation, and the integration of social goals in inclusive science learning.

Keywords: differentiated learning, interpersonal skills, students with disabilities, inclusive education, science learning.

INTRODUCTION

Interpersonal skills are a critical component of students' holistic development and social participation. These skills enable learners to communicate effectively, collaborate with others, and build healthy social relationships that support both academic and personal success.

For students with disabilities, the development of interpersonal skills is often more challenging. Barriers related to communication, collaboration, and peer interaction are frequently reported among students with physical, sensory, and intellectual disabilities. Recent studies indicate that limited opportunities for meaningful interaction can significantly hinder their social engagement (Alshahrani, 2022; Sagun-Ongtangco et al., 2021).

Inclusive education offers an important framework for addressing these challenges by allowing students with and without disabilities to learn together in the same classroom. Such environments create natural contexts for daily social interaction, peer learning, and shared experiences that are essential for social development.

However, empirical evidence shows that inclusive practices often fail to produce optimal social outcomes. One major contributing factor is teachers' limited preparedness in managing diverse learning needs, which can result in minimal interaction and passive participation of students with disabilities despite their physical inclusion in regular classrooms (Gheyssens et al., 2022; Bryant et al., 2019).

To respond to learner diversity more effectively, recent literature emphasizes differentiated learning as a promising pedagogical approach. Differentiated instruction involves adjusting learning content, processes, and outcomes according to students' readiness, interests, and learning profiles, thereby creating more inclusive and responsive learning experiences (Caulfield, 2023; Qorib, 2024).

When implemented appropriately, differentiated learning has been shown to enhance student engagement, autonomy, and social participation, particularly in inclusive settings. Studies suggest that flexible instructional strategies can help students

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with disabilities feel valued and supported, which in turn encourages more active involvement in classroom interactions (Fisher & Frey, 2021; Meeusen & Boonen, 2022).

Science education at the elementary level presents unique opportunities for interpersonal skill development. Learning activities in science commonly involve inquiry, experimentation, and collaborative group work, all of which require communication, cooperation, and shared responsibility among students.

Recent research demonstrates that collaborative science learning can strengthen communication skills, teamwork, and social responsibility, including for students with disabilities (Hartman & Squires, 2024; Kumar & Praveenakumar, 2025). Despite this potential, most studies in inclusive science education remain focused on cognitive achievement or accessibility rather than social skill development.

This reveals a significant research gap. Interpersonal skills do not automatically emerge through inclusion alone; they require intentional pedagogical design and facilitation. Prior studies rarely examine how differentiated learning functions as a strategic mechanism for fostering social interaction, peer collaboration, and self-confidence among students with disabilities in inclusive science classrooms, particularly in developing country contexts such as Indonesia.

Therefore, this article aims to analyze the role of differentiated learning in developing interpersonal skills of students with disabilities through inclusive science (IPA) learning. The novelty of this study lies in its integration of differentiated instruction and interpersonal skill development, positioning science learning not only as a cognitive domain but also as a social space that supports students' social-emotional growth and holistic development.

METHODS

This study employed a Systematic Literature Review (SLR) design with a descriptive qualitative approach. This design was chosen to gain a comprehensive and structured understanding of the development of interpersonal skills in students with disabilities through differentiated learning, particularly in the context of science learning in inclusive educational settings. SLR enables researchers to systematically identify, evaluate, and synthesize empirical and conceptual findings using transparent and replicable procedures (Fink, 2019; Cooper et al., 2018).

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Research data sources were obtained from reputable national and international journal articles, academic books, and relevant research reports. The literature search was conducted through several major scientific databases, namely Scopus, Web of Science, ERIC, Google Scholar, and DOAJ. Keywords used in the search process included "interpersonal skills," "students with disabilities," "differentiated learning," "inclusive education," and "science learning," both singly and in combination, to ensure a relevant and representative coverage of the literature.

The literature selection process was conducted by strictly applying inclusion and exclusion criteria. Inclusion criteria included: (1) articles discussing differentiated learning, inclusive education, or interpersonal skills development; (2) research subjects including students with disabilities; (3) the context of primary education or equivalent; (4) articles published in peer-reviewed scientific journals; and (5) publications within the last five years (2020–2025) to ensure the recency of the findings. Meanwhile, exclusion criteria included non-scientific articles, publications irrelevant to the research focus, opinion studies without empirical basis, and articles not available in full text.

Based on the initial database search, a total of 87 articles were identified. After screening titles and abstracts using predetermined inclusion and exclusion criteria, 42 articles were retained for further consideration. Following a rigorous full-text review focusing on relevance to differentiated learning, inclusive science education (ISC), and interpersonal skill development for students with disabilities, only a small number of highly relevant and theoretically grounded studies were selected for in-depth analysis. This final selection ensured analytical depth and conceptual consistency rather than broad numerical coverage.

Data analysis was conducted using thematic content analysis, critically reviewing the literature and grouping findings based on key emerging themes, such as differentiated learning, social interaction, inclusive education, and interpersonal skills development in students with disabilities (Snelson, 2016; Fellows & Liu, 2021). Each article was analyzed to identify conceptual relationships and empirical evidence supporting the effectiveness of differentiated learning strategies in improving the quality of students' social interactions.

The analysis results were then synthesized in an integrative manner to build a holistic understanding of the role of differentiated learning in interpersonal skills development. The synthesis process involved comparing, contrasting, and integrating various research findings, resulting in robust conceptual conclusions and practical

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pedagogical recommendations for implementing inclusive and adaptive science learning. This approach enabled the research not only to map existing theory but also to emphasize the practical contribution of differentiated learning in supporting the social-emotional development of students with disabilities.

RESULTS AND DISCUSSION

This study presents data obtained from a focused literature review of eight peer-reviewed empirical articles published between 2021 and 2025, all of which examined differentiated learning in inclusive education. The selected articles were analyzed to identify patterns in how differentiated learning contributes to the development of interpersonal skills among students with disabilities, particularly in science learning.

The literature review revealed consistent attention to process differentiation, flexible grouping, and role-based collaboration as primary instructional strategies. Across the studies, interpersonal skill development was operationalized through indicators such as social participation, communication and collaboration, self-confidence, and the quality of peer interactions. Table 1 summarizes and compares these findings, highlighting the focus of each study and its primary contribution to understanding differentiated learning as a social mechanism in inclusive classrooms.

Table 1. Comparison of Literature Reviews Related to Differentiated Learning for Students with Disabilities.

Author(s)	Year	Focus of Study	Key Findings
Gheyssens et al.	2022	Differentiated instruction in inclusive classrooms	Differentiated processes and flexible grouping significantly improve social participation and peer interaction of students with disabilities
Meeusen & Boonen	2022	Teacher differentiation practices in inclusive education	Effective differentiation supports both academic engagement and interpersonal development when aligned with student readiness
Alshahrani	2022	Differentiated instruction in science learning	Differentiated science instruction enhances collaboration and communication skills among diverse learners

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Fisher & Frey	2021	Structured differentiation and student collaboration	Clear role distribution and scaffolded tasks reduce social anxiety and promote cooperative learning
Caulfield	2023	Inclusive pedagogy and student voice	Multiple modes of expression increase self-confidence and social agency of students with special needs
Hartman & Squires	2024	Collaborative learning in inclusive STEM classrooms	Differentiated roles in group-based science activities foster meaningful peer interaction
Hellison et al.	2025	Social-emotional learning in inclusive instruction	Differentiated learning contributes to interpersonal skill development when embedded in supportive classroom climates
Sagun-Ongtangco et al.	2021	Inclusive classroom dynamics	Peer-mediated strategies enhance the communication and social belonging of students with disabilities

Table 1 reveals converging evidence suggesting that differentiated learning plays a substantive role in strengthening the interpersonal skills of students with disabilities; however, the mechanisms and conditions for its effectiveness vary across studies.

The study by Gheyssens et al. (2022) and Meeusen & Boonen (2022) emphasizes process-based differentiation, specifically flexible grouping and adaptive task structures, as key drivers of increased social participation. These findings suggest that interpersonal engagement does not emerge automatically from inclusion but requires deliberate instructional design that enables students with disabilities to interact meaningfully with peers. In contrast, Alshahrani (2022) situates differentiated learning in the specific context of science, demonstrating that collaborative science activities enhance communication opportunities when task complexity is matched to student readiness. This comparison highlights that subject context matters, and science learning offers unique opportunities for social interaction due to its inquiry-based nature.

Further differentiation emerges in studies focusing on communication and collaboration. Fisher & Frey (2021) and Hartman & Squires (2024) emphasize the importance of role clarity in group work. In contrast to more common models of differentiation, these studies demonstrate that assigning structured roles (e.g., observer, recorder, presenter) reduces social anxiety and encourages equitable participation. This suggests that differentiation is most effective when it goes beyond content adaptation and explicitly addresses interactional roles in learning activities.

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Regarding self-confidence and social agency, Caulfield (2023) and Hellison et al. (2025) highlight the role of multiple modes of expression and a supportive classroom climate. Their findings suggest that differentiated learning contributes to interpersonal development not only through instructional variation but also through recognition of students' social identities and communicative strengths. This contrasts with previous deficit-oriented perspectives, which position students with disabilities as active social agents rather than passive recipients of support.

However, this synthesis also identifies important limitations. While most studies report positive outcomes, Sagun-Ongtangco et al. (2021) note that peer-mediated strategies require ongoing teacher facilitation to prevent superficial inclusion. This aligns with broader findings that differentiated learning may fail to improve interpersonal skills when implemented without adequate teacher competency, time for planning, or inclusive classroom norms.

Importantly, none of the reviewed studies positioned interpersonal skill development as a primary outcome in science learning; instead, it often emerged as a secondary benefit. This reveals a research gap that this study addresses—namely, the need to conceptualize differentiated learning in inclusive science classrooms not only as an academic strategy but as an intentional social intervention aimed at strengthening the interpersonal competencies of students with disabilities.

Differentiated Learning as a Mechanism for Interpersonal Skill Development

The findings indicate that differentiation—especially at the process level—enables students to engage in social interactions through flexible grouping, adaptive task roles, and structured collaboration. This instructional setting allows students with disabilities to actively participate in peer interactions without being constrained by uniform academic demands.

Theoretically, these findings align with Social Learning Theory, which states that social competence develops through interaction, observation, and reinforcement. The structure of differentiated learning creates repeated opportunities for students to observe peer behavior, practice communication strategies, and receive feedback, thus supporting the gradual internalization of interpersonal skills.

Inclusive Science Learning as a Space for Social Interaction

The reviewed evidence highlights science learning as a highly effective space for interpersonal development when differentiation is implemented intentionally. Inquiry-based activities, experiments, and collaborative problem-solving require

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communication, negotiation, and shared responsibility. Differentiated learning reduces interaction barriers by aligning task complexity with student readiness, enabling equal participation in this social process.

This synthesis extends existing research by demonstrating that science learning not only accommodates students with disabilities but also actively supports the development of interpersonal competencies when instructional variations are intentionally incorporated. Thus, differentiated science learning serves as a dual-purpose strategy that promotes cognitive engagement and social interaction.

Self-Confidence and Social Skills as Key Outcomes

Beyond observable interaction patterns, this synthesis identifies self-confidence and social skills as key outcomes of differentiated learning. Students with disabilities demonstrated increased willingness to express ideas, take roles in group work, and initiate interactions when provided with multiple modes of participation. These findings suggest that differentiation contributes to interpersonal development by fostering a sense of competence and social recognition.

These patterns suggest that interpersonal skills are strengthened not only through frequent interactions but also through meaningful participation that affirms students' social values within the classroom. Thus, differentiated learning supports interpersonal growth by enabling students to experience successful social exchanges.

Structural Barriers to Implementation

While the findings are generally positive, several studies report limitations that limit the effectiveness of differentiated learning. Inadequate teacher preparation, limited lesson planning time, a lack of adaptive learning resources, and unsupportive peer dynamics mitigate the impact of differentiation on interpersonal skill development. These findings suggest that differentiation alone is not sufficient without ongoing learning support and intentional facilitation of peer interactions.

CONCLUSION

This study analyzes the role of differentiated learning in developing the interpersonal skills of students with disabilities through inclusive science learning. A synthesis of the reviewed studies indicates that differentiated learning strengthens social participation, communication, collaboration, and self-confidence when implemented through process-oriented instructional design. By aligning learning activities with

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students' readiness and participation styles, differentiated learning facilitates meaningful peer interactions and equitable social engagement.

These findings position differentiated learning as a social learning mechanism that supports the development of interpersonal skills through structured interaction, observation, and guided participation. In science learning, inquiry-based and collaborative activities provide effective opportunities for students with disabilities to practice communication and collaboration in ways that respect individual learning differences.

Practically, differentiated science learning is most effective when supported by clear instructional design, flexible role assignments, and ongoing teacher facilitation. Educators are encouraged to integrate social interaction goals into science instruction, implement multiple modes of participation, and encourage structured peer collaboration. Future research should focus on developing and empirically testing integrated learning models that combine differentiated learning, collaborative learning, and peer learning to strengthen the interpersonal skills of students with disabilities in inclusive science education.

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