
ASSESSING THE SOCIAL INTEGRATION OF INTELLECTUAL DISABILITIES STUDENTS IN MAINSTREAM EDUCATIONAL ENVIRONMENTS

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ABSTRACT

Intellectual Disability (ID) is clinically characterized by distinct deficits in both intellectual functioning and adaptive behavior, which can severely impact a student's ability to navigate complex social settings. While modern educational policies increasingly advocate for inclusive schooling, merely placing students with ID in mainstream classrooms does not automatically equate to meaningful social integration or peer acceptance. This paper proposes a novel; multimodal assessment framework designed to objectively measure and understands the social integration of ID students in mainstream educational environments. By combining Social Network Analysis (SNA) with specialized Facial Expression Recognition (FER) and cognitive accessibility metrics, we provide a holistic method for evaluating interpersonal interactions and emotional engagement. Ultimately, this framework aims to transition educational models from superficial physical inclusion to active, self-determined social participation, providing educators with actionable data to support vulnerable learners.

KEYWORDS: Social Integration, Mainstream Education, Environmental and Functioning Etc.

INTRODUCTION

Intellectual Disability is a developmental condition marked by significant limitations in intellectual capacities—such as learning, reasoning, and problem-solving—as well as in adaptive behaviors encompassing conceptual, social, and practical everyday skills (Chen et al., 2024). The global push toward inclusive education has led to a higher prevalence of

students with ID attending mainstream schools alongside their neurotypical peers. The fundamental goal of this inclusion is to foster equitable learning opportunities and promote social cohesion from an early age. However, achieving genuine social integration remains a profound challenge, as the presence of a student in a classroom does not guarantee that they are actively participating in the social fabric of the peer group.

The theoretical foundation of student retention and success heavily emphasizes the dual pillars of academic and social integration (Zwolak & Brewe, 2015). Students' academic and social assimilation into their learning environment is vital for their persistence and overall well-being (Zwolak & Brewe, 2015). For students with ID, integration also heavily intersects with the concept of self-determination, which is the ability to act directly on one's life by making free choices without undue external influence (Laronze et al., 2025). When social integration is lacking, it often directly diminishes a student's self-determination, leading to isolation, reduced academic persistence, and an inability to live an independent life with favorable conditions of well-being (Laronze et al., 2025).

Despite the critical importance of evaluating how well ID students are socially integrating, existing assessment approaches are largely insufficient for several reasons. First, current methodologies rely heavily on subjective teacher observations or standardized behavioral checklists, which fail to capture the nuanced, peer-to-peer micro-interactions that constitute true social integration. Second, existing evaluation tools do not adequately account for the atypical non-verbal communication and affective expressions often exhibited by individuals with ID, leading to systematic misinterpretations of their emotional engagement and social comfort. Finally, traditional approaches often treat academic capability and social integration as isolated variables, ignoring how cognitive accessibility directly mediates social participation.

To address these critical gaps, this paper introduces a comprehensive methodology for assessing the social integration of ID students in mainstream classrooms. Specifically, the contributions of this work are as follows:

- We propose a novel, multimodal assessment framework that synergizes social network analysis with automated, ID-tailored facial expression recognition to objectively quantify peer integration.
- We delineate a hypothetical evaluation protocol designed to measure how cognitive accessibility interventions, such as automated text simplification, directly impact the peer centrality and social persistence of students with intellectual disabilities.

Review of Literature

Theoretical Models of Social Integration and Self-Determination

The discourse on student integration has long been anchored by Vincent Tinto's integration model, which introduced the notion that internal classroom communities profoundly affect a student's integration into the broader academic and social environment (Zwolak & Brewe, 2015). Tinto's framework asserts that interpersonal interactions and active participation in learning communities are critical predictors of student persistence (Zwolak & Brewe, 2015). Parallel to this, Wehmeyer's functional model of self-determination defines the construct as a set of skills allowing individuals to make uncoerced choices to maintain or improve their quality of life (Laronze et al., 2025). The strength of these theoretical models lies in their robust conceptualization of human agency and social belonging. However, their primary weakness is that they were not originally designed to quantify the specific integration barriers faced by individuals with cognitive impairments. Our work bridges this gap by operationalizing Tinto's concepts of social integration and Wehmeyer's self-determination through the lens of multimodal assistive technologies specifically calibrated for ID populations.

Assistive Technologies and Cognitive Training

Recent advancements in human-computer interaction have introduced various technologies aimed at supporting the cognitive and therapeutic needs of individuals with ID. For instance, immersive Virtual Reality (VR) games like Space Exodus have been designed to support therapy by integrating everyday life scenarios into task-based role-playing environments, thereby enhancing concentration and hand-eye coordination (Chen et al., 2024)(Berrezueta-Guzman et al., 2025). Similarly, socially assistive virtual agent tutors, such as the RoboCamp system, have been deployed in sheltered workshops to provide attention training for individuals with ID, particularly addressing the frequent co-occurrence of Attention Deficit Hyperactivity Disorder (ADHD) in this population (Leichert et al., 2025). A major strength of these interventions is their ability to provide consistent, engaging, and repeatable therapeutic tasks (Berrezueta-Guzman et al., 2025). Conversely, a significant limitation is that these technologies are often applied in isolated or clinical settings rather than in mainstream, dynamic classrooms. While our research draws on the technical foundations of these engaging digital platforms, it diverges by focusing on assessing naturalistic social integration in unconstrained classroom environments rather than isolated therapeutic skill acquisition.

Affective Computing and Communication Accessibility

The use of social robotics and affective computing has expanded to include Facial Expression Recognition (FER), which imparts machines with the capacity to discern user emotional states (Gaya-Morey et al., 2024). However, traditional deep learning approaches for FER often fail when applied to individuals with ID, as their facial expressions can differ significantly from neurotypical populations, necessitating tailored, user-specific training methodologies (Gaya-Morey et al., 2024). Furthermore, explainability techniques like LIME and RISE have been explored to make these neural networks more transparent when analyzing expressions of people with ID (Guarinos et al., 2024). On the linguistic front, Automatic Text Simplification (ATS) leveraging Large Language Models (LLMs) and Direct Preference Optimization (DPO) has been utilized to enhance language accessibility for persons with ID (Gao et al., 2025). Evaluating the comprehensibility of these simplified texts using objective measures like reading speed and multiple-choice questions has proven essential for this target group (Säuberli et al., 2024). A strength of these distinct domains is their focus on customizing algorithms for the ID demographic. However, they are rarely combined into a unified assessment tool. Our approach uniquely synthesizes customized FER and ATS metrics to evaluate how communicational accessibility impacts emotional and social integration.

Method/Approach

To overcome the limitations of subjective and fragmented evaluation methods, we propose the Multimodal Integration Assessment (MIA) Framework. This framework is designed to capture, quantify, and analyze the social integration of ID students in mainstream educational settings through a combination of structural, affective, and cognitive data streams. The core rationale behind this design is that social integration cannot be measured by physical proximity alone; it requires an understanding of network position, emotional valence during interactions, and the accessibility of the shared environment.

The MIA Framework operates through a structured, three-step pipeline that continuously monitors and evaluates the student's integration status. The numbered pipeline is defined as follows:

- 1. Social Network Analysis (SNA) Module:** This module captures interaction frequencies between students during group activities. Drawing inspiration from methodologies that use SNA to identify patterns contributing to university integration (Zwolak & Brewe,

2015), we apply centrality metrics to classroom data. By calculating the degree centrality and betweenness centrality of the ID student within the classroom network, the system establishes a quantitative baseline of structural peer inclusion.

2. **Affective Engagement Module:** During recorded social interactions, this module utilizes explainable Artificial Intelligence to analyze the emotional state of the ID student. Because generic FER models perform poorly on this demographic, we utilize an ensemble of Convolutional Neural Networks (CNNs) trained specifically on datasets featuring individuals with ID (Gaya-Morey et al., 2024). Explainability techniques, such as RISE and LIME, are integrated to ensure the model focuses on the correct facial regions (Guarinos et al., 2024), providing educators with reliable data on the student's emotional comfort and social receptivity.
3. **Cognitive Accessibility Correlation Module:** This final step evaluates the shared academic materials using digital comprehensibility assessments (Säuberli et al., 2024). It tracks whether the texts used in collaborative tasks have undergone personalized Automatic Text Simplification via Direct Preference Optimization (Gao et al., 2025). The framework then correlates the linguistic complexity of the task with the SNA and FER outputs to determine if social isolation is a byproduct of cognitive overload or genuine social exclusion.

To validate the proposed MIA Framework, we have designed a hypothetical evaluation plan based in a mainstream middle school environment. In this hypothetical setup, a cohort of 50 classrooms—each containing at least one student diagnosed with ID—will be monitored over a single academic semester. We will collect anonymized peer interaction logs, video snippets of collaborative group work, and reading comprehension scores based on customized simplified texts. The primary benchmark for success will be a statistically significant positive correlation between the ID students' SNA centrality scores and their affective valence scores as measured by the tailored FER models. Furthermore, we will compare integration trajectories between classrooms that utilize LLM-based text simplification (Gao et al., 2025) versus those using standard curricula, hypothesizing that higher cognitive accessibility directly facilitates denser social networks.

DISCUSSION

The practical deployment of the Multimodal Integration Assessment Framework in mainstream educational environments carries significant implications for pedagogical strategies. By providing educators with objective, data-driven insights into a student's social

network centrality and emotional well-being, teachers can move away from reactive interventions. Instead, they can proactively design collaborative tasks that pair ID students with highly central, empathetic neurotypical peers, thereby fostering organic integration. Furthermore, embedding these technological assessments into daily classroom routines can help cultivate environments where self-determination is actively supported, allowing students with ID to make free choices and improve their quality of life (Laronze et al., 2025).

Despite its potential, the proposed framework faces several critical limitations and failure modes that must be addressed.

- First, the high variance in physical and cognitive traits among individuals with ID means that even specialized FER models may struggle to achieve high accuracy for every unique user (Gaya-Morey et al., 2024). The requirement for tailored, user-specific training methodologies can be computationally expensive and difficult to scale across entire school districts (Gaya-Morey et al., 2024).
- Second, continuous monitoring of social interactions and facial expressions in a classroom setting introduces the risk of the "Hawthorne effect," where students alter their natural behavior simply because they know they are being observed, potentially skewing the SNA metrics.
- Third, the framework does not currently account for the confounding variables introduced by Multiple Long-Term Conditions (MLTC). Individuals with ID often experience an earlier onset and higher prevalence of MLTCs compared to the general population (Kousovista et al., 2024). Frequent health-related absences disrupt the temporal continuity required to build strong social ties, which could result in low SNA centrality scores that reflect medical reality rather than social exclusion.

The deployment of affective computing and surveillance technologies in classrooms also raises profound ethical considerations and risks.

- Primarily, there is a significant risk of algorithmic bias and misinterpretation; if an FER system inaccurately categorizes an ID student's atypical resting facial expression as negative or disengaged, it could lead to unwarranted psychological interventions or further stigmatization.
- Additionally, issues surrounding informed consent are paramount when dealing with vulnerable populations (Laronze et al., 2025). Ensuring that students with ID and their guardians fully comprehend the scope of data collection, and have the autonomous right to opt-out without facing educational penalties, is a non-negotiable ethical prerequisite.

- Looking ahead, future work must focus on expanding the scope and fairness of the assessment methodologies.

One critical avenue for future research is the integration of longitudinal Electronic Health Records (EHR) data to better understand the disease trajectories and co-occurrences of MLTCs (Kousovista et al., 2024). By cross-referencing health trajectories with classroom integration data, researchers can develop a more contextualized understanding of a student's social availability.

- Another necessary direction for future work involves the development of real-time, privacy-preserving teacher dashboards. These interfaces should translate complex neural network outputs and explainability heatmaps (Guarinos et al., 2024) into intuitive, actionable alerts for educators, enabling them to facilitate immediate and supportive social interventions without storing sensitive biometric data permanently.

CONCLUSION

The meaningful social integration of students with Intellectual Disabilities in mainstream educational environments represents a complex, multifaceted challenge that extends far beyond physical classroom inclusion. Recognizing the profound impact that social integration has on student persistence and self-determination, this paper introduced the Multimodal Integration Assessment (MIA) Framework. By synergizing Social Network Analysis, ID-tailored Facial Expression Recognition, and cognitive accessibility metrics, our approach offers a rigorous, objective lens through which to evaluate peer interactions and emotional engagement.

Ultimately, leveraging customized technologies to assess and support vulnerable populations marks a necessary evolution in inclusive education. While limitations regarding algorithmic scalability and the confounding effects of co-occurring health conditions remain, the proposed framework lays a robust foundation for future interdisciplinary research. By prioritizing transparent AI and preserving student autonomy, educational institutions can utilize these tools to dismantle invisible social barriers, ensuring that students with intellectual disabilities are not merely present in the classroom, but are valued, integrated, and self-determined members of their academic communities.

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