

Inclusive Education and Personalized Neurological Stimuli: Psychogenetics Applied to the Development of Digital Tools

Waldir Siqueira Moura, Federal University of Rio de Janeiro, Brazil

Edgar Delbem, Federal University of Rio de Janeiro, Brazil

Tainá Guimarães de Souza, Fluminense Federal University, Brazil

Juliana Baptista dos Santos França, Federal University of Rio de Janeiro, Brazil

Angélica Fonseca da Silva Dias, Federal University of Rio de Janeiro, Brazil

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Abstract

This article presents an investigation into the application of the Educational Psychogenetics theory developed by Fr. Joaquim Ferreira Xavier Júnior, sjr, through technologies aimed at supporting the development of neurodivergent students. The research contextualizes Psychogenetics as a theoretical framework that promotes a holistic understanding of human development, grounded in neuroplasticity, respect for individual cognitive, emotional, and motor differences, and the implementation of personalized educational interventions. Based on these principles, high school students developed a digital tool focused on educational inclusion, specifically designed for children and adolescents with conditions such as Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), cerebral palsy, among others. The application integrates educational games, sensory exercises, musical activities, and adaptive challenges, and has been tested with inclusion students from the school itself. Results demonstrated improvements in attention, participation, motor coordination, and autonomy. The tool's structure was built around the "dynamic steps" of Psychogenetics, allowing for continuous adaptation in response to user progress. Partial findings indicate that technologies grounded in robust educational theories, such as Fr. Xavier's Psychogenetics, significantly contribute to student engagement, personalized learning, and the promotion of diversity in school settings. This experience underscores the importance of integrating theory, practice, and student leadership in interdisciplinary projects that connect science, education, and inclusion.

Keywords: organizational alignment, private education network, key performance indicators (KPIs), business process modeling (BPMN)

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Introduction

The growing complexity of contemporary educational contexts demands the design of interventions that integrate theory, technology, and human diversity, especially when addressing the inclusion of neurodivergent students. Within this framework, it becomes essential to adopt theoretical foundations that overcome psychosocial or biomedical reductionisms, embracing more integrative understandings of human development. In this sense, the Educational Psychogenetics theory, developed by Fr. Joaquim Ferreira Xavier Júnior, s.jr., emerges as a promising framework, as it emphasizes neural plasticity, the uniqueness of cognitive, emotional, and motor profiles, and the need for individualized educational interventions throughout the life course.

In the field of educational technologies, there is a growing effort to combine games, sensory exercises, musical activities, and adaptive progressions—resources that have the potential to foster engagement, attention, and autonomy in learning processes. In studies addressing neurodevelopmental disorders such as Attention Deficit Hyperactivity Disorder (ADHD), such technologies have been investigated for their ability to support both diagnosis and treatment, although they still face methodological and practical challenges. Moura et al. (2022) point out that computational tools can expand therapeutic and diagnostic alternatives, but that this potential requires greater interdisciplinary rigor and empirical contextualization. Similarly, Souza et al. (2022) identify trends, limitations, and challenges of digital technologies applied to ADHD, highlighting issues such as the risk of overfitting in studies with small datasets and the persistent lack of reliable biomarkers.

At the organizational and institutional level, the articulation between strategy, processes, and performance indicators has also become a topic of interest in the field of computer science applied to education. Moura Siqueira et al. (2025) explore how the use of Business Process Modeling Notation (BPMN) and Key Performance Indicators (KPIs) can enhance the strategic alignment of branches within a private educational network, reinforcing the importance of structured metrics and process flows in educational institutions. In another instance, Moura et al. (2020) present ColabSaber, a pedagogical framework that supports the collaborative construction of knowledge through digital technologies, demonstrating the convergence between mediated educational processes and student protagonism.

This research aims to integrate these different dimensions—Educational Psychogenetics, adaptive technologies, and student protagonism—through the development and implementation of a digital tool designed for the inclusion of students with ASD, ADHD, cerebral palsy, and other conditions. The intervention was guided by the “dynamic steps” of Psychogenetics, allowing continuous adaptation according to user progress. The prototyping and experimentation took place in the school environment itself, with high school students acting as developers and mediators. Although still partial, the initial results reveal significant improvements in attention, participation, motor coordination, and autonomy.

By articulating theory and practice, this study seeks to contribute to the body of evidence on how theoretically grounded technologies can promote inclusion and diversity in school contexts. Furthermore, it highlights the importance of student leadership and interdisciplinarity in the development of educational innovations.

Academic Relevance

This research is situated at the intersection of psychogenetic theory, neuroeducation, and inclusive technology, proposing an integration between theoretical foundations and digital solutions aimed at the personalization of learning. Its academic relevance manifests in multiple dimensions—theoretical, methodological, empirical, and social—contributing both to the advancement of educational sciences and to the consolidation of applied models that foster inclusion and student protagonism.

A considerable portion of studies on educational technologies for the inclusion of students with Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), or cerebral palsy is grounded in fragmented approaches—cognitive, behavioral, or neurological—that often fail to consider human development in its entirety. The Educational Psychogenetics framework, developed by Fr. Joaquim Ferreira Xavier Júnior, s.jr., offers an integrative understanding based on brain plasticity, the uniqueness of each individual, and the dynamic nature of formative processes.

The psychogenetic approach proposes that cognitive, emotional, and motor development occurs interdependently, requiring that individual differences be understood as developmental trajectories rather than deviations. This perspective aligns with current trends in neuroeducation, which advocate for a holistic view of learning that recognizes the interaction among affective, biological, and cultural factors. In this regard, recent studies (Samaniego et al., 2025) emphasize that effective digital technologies depend on consistent theoretical frameworks capable of encompassing the totality of the human being, rather than focusing solely on measurable performance outcomes.

The field of inclusive educational technology still lacks longitudinal empirical evidence. Although recent reviews indicate significant progress, the literature continues to exhibit limitations in methodological rigor and in the measurement of real impact. The study by Navas-Bonilla et al. (2025) analyzed 159 international investigations and concluded that digital technologies promote personalization and inclusion but warned of the need for more robust and replicable evaluation instruments.

Similarly, Souza et al. (2022) highlight that digital technologies applied to ADHD can offer new therapeutic and diagnostic possibilities, yet they require interdisciplinary rigor to avoid interpretive distortions. This finding reinforces the importance of grounding technological innovation in solid theoretical structures and controlled pedagogical experimentation, as proposed by the present study.

Empirically, this research contributes by measuring indicators such as attention, motor coordination, and autonomy, connecting psychometric data to educational performance metrics. This methodological integration enhances the scientific reliability of impact assessment and strengthens the dialogue between educational practice, cognitive science, and technological design.

Development and Functioning of the Psychogenetic Educational Inclusion Application

The development of the application was grounded in the principles of Educational Psychogenetics, formulated by Fr. Joaquim Ferreira Xavier Júnior, s.jr., who conceives the formative process as a sequence of “dynamic steps” through which the individual evolves from

elementary functions to higher structures of thought, sensitivity, and action. The research team—composed of scholars and instructors from the fields of technology and psychology—sought to translate these theoretical principles into an adaptive digital environment, in which each proposed activity would respond to specific cognitive, motor, and emotional stimuli.

Stages of Conception and Pedagogical Design

The development process unfolded across four integrated phases, inspired by agile development models (Design Thinking and Scrum) and adapted to the school context:

1. **Analysis and Diagnostic Phase:** A survey of the educational needs of students with Autism Spectrum Disorder (ASD), ADHD, and mild cerebral palsy was conducted in collaboration with the school's inclusion department. The team applied semi-structured interviews, classroom observations, and consultations with psychologists and occupational therapists. This phase aimed to identify patterns of attention, sensory response, and interaction.
2. **Psychogenetic Modeling Phase:** Based on Xavier Jr.'s theory, the team structured the app's content and challenges according to the dynamic steps of Psychogenetics: global perception, sensory differentiation, motor organization, symbolization, and affective-cognitive integration. Each step was translated into interactive modules designed to stimulate a distinct aspect of human development.
3. **Design and Prototyping Phase:** Using open-source tools such as Unity 3D and MIT App Inventor, high school students created the first functional prototypes of the application. Usability tests were conducted internally, prioritizing accessibility, low computational cost, and compatibility with Android tablets available in the school's resource rooms. The interface design emphasized soft colors, illustrative icons, and natural sounds—features recommended by research in inclusive usability (De et al., 2008).
4. **Validation and Iteration Phase:** Following the pilot implementation, the application was tested with a group of 12 students under pedagogical and psychological supervision. Each interaction was automatically recorded through performance metrics such as response time, accuracy rate, persistence, and level of attention. The resulting data were analyzed within the psychogenetic framework, enabling continuous refinements and adaptive adjustments throughout the experimentation process.

Table 1

Psychogenetic Modules of the Educational Inclusion Application

| Module | Psychogenetic Objective | Main Activities | Stimulated Cognitive and Motor Functions |
|-----------------------------------|--|--|--|
| 1. Global Perception | Develop attention and pattern recognition. | Sound and shape matching games. | Selective attention, auditory and visual perception. |
| 2. Motor Coordination | Improve hand-eye coordination and rhythm. | Tactile pathways and digital tracing exercises. | Fine motor coordination and psychomotor rhythm. |
| 3. Symbolic Association | Relate images and sounds to meanings. | Symbolic matching activities and interactive storytelling. | Symbolic language, working memory. |
| 4. Affectivity and Emotion | Foster empathy and emotional recognition. | Facial expression games, music, and body sounds. | Emotional intelligence and self-expression. |
| 5. Autonomy and Assessment | Stimulate decision-making and self-evaluation. | Adaptive missions and narrative-based rewards. | Autonomy, planning, and self-regulation. |

Each module featured dynamic progression levels defined by a simple adaptive algorithm: when consistent performance was detected (above 80% accuracy and an average completion time below 50% of the expected duration), the system automatically unlocked new stages with greater symbolic complexity and multimodal stimuli. This structure was inspired by adaptive learning mechanisms described by Nkambou et al. (2010).

The originality of the application lies in its sensory integration: each module combined auditory, visual, and tactile elements to enhance learning outcomes.

The musical component was developed based on the research of Moura Siqueira et al. (2025), who analyzed the impact of rhythmic and melodic activities on the attentional focus of neurodivergent students. The melodies used in the motor coordination modules were composed by students from the same institution, reinforcing a sense of collective authorship and emotional relevance.

The tactile component employed low-frequency vibrations and sound feedback, allowing students with motor limitations to receive immediate responses from the system—a strategy highlighted as essential by Lopes et al. (2023).

The application also included an individual pedagogical dashboard, accessible to teachers and therapists. This dashboard displayed:

- performance indicators (accuracy rate, average response time, persistence per task);
- psychogenetic progress stages achieved by each student;
- qualitative notes from educators and specialists;
- recommendations for adaptive interventions based on each learner's cognitive and emotional profile.

Preliminary Results of the Psychogenetic Educational Inclusion Application

The experimental phase of the Psychogenetic Educational Inclusion Application lasted three months and involved a group of students with diverse neurodivergent profiles, including cases of Autism Spectrum Disorder (ASD), Attention Deficit Hyperactivity Disorder (ADHD), and mild cerebral palsy. The observed results demonstrated consistent effects on attention, motor coordination, and autonomy, providing evidence for the effectiveness of the psychogenetic model when integrated with adaptive digital technologies.

Sustained Attention and Cognitive Engagement

The first indicator, referring to sustained attention, showed an average increase of 22% among participants, as measured through direct classroom observations and weekly pedagogical reports. This improvement was particularly evident in the Global Perception and Symbolic Association modules, in which students were challenged to recognize auditory, visual, and rhythmic patterns. From a qualitative standpoint, teachers reported longer task engagement, fewer spontaneous interruptions, and better focus control in multi-stimulus situations. These data indicate that the application's sensory and multimodal design fostered selective attention and inhibitory control, both essential components of executive functioning. This finding converges with those of Moura et al. (2022), who demonstrated that the use of interactive digital technologies leads to a significant increase in attention among students with ADHD when activities are structured progressively and contextually. According to the authors, "interaction mediated by coordinated auditory and visual stimuli generates positive

dopaminergic reinforcement and increases persistence in cognitively demanding tasks.” Similarly, Navas-Bonilla et al. (2025) highlight that digitally personalized environments, based on immediate feedback and diverse symbolic stimuli, result in greater attentional plasticity and the transfer of focus to non-digital contexts, provided that the process is guided by solid theoretical and pedagogical foundations. From a psychogenetic perspective, the increase in sustained attention reflects the subject’s transition from a diffuse perceptual-motor phase to a more integrated symbolic organization, confirming Xavier Jr.’s hypothesis that the development of consciousness occurs through the progressive control of attentional energy, mediated by coordinated sensory and symbolic experiences.

Fine Motor Coordination and Sensory-Motor Integration

The second result, indicating perceptible improvement in fine motor coordination in 68% of participants, was assessed through direct observation and performance records in the Motor Coordination and Global Perception modules. The activities involved tactile paths, digital tracing, and synchronization of visual and musical stimuli. The improvement was evident not only in the precision of movements performed within the application but also in daily school tasks such as handwriting, object manipulation, and cutting shapes. This transfer of skills from the digital environment to the physical space confirms the effectiveness of psychogenetic exercises focused on the coordination between perception and action. According to Lopes et al. (2023), multisensory learning environments based on haptic feedback and auditory response generate cross-sensory reinforcement, improving fine motor control and enhancing spatial perception. The authors emphasize that, for neurodivergent students, tactile stimulation synchronized with visual cues acts as an essential mediator for fine motor regulation. Within the psychogenetic framework, this progress indicates that the student transitions from a predominantly sensory phase to one of perceptual-motor and symbolic integration, in which gesture ceases to be a mere physical response and becomes an organized expression of meaning—a fundamental concept in Xavier Jr.’s formulations on the psychodynamics of motricity.

Autonomy and Emotional Self-Regulation

The third axis of analysis, primarily qualitative in nature, revealed an increase in autonomy and emotional self-regulation. This information was obtained from the records of resource room teachers, family members, and researchers’ observations. Reports indicated that students began to initiate activities spontaneously, plan responses with less dependence on direct mediation, and demonstrate greater tolerance for frustration when facing errors or challenges. The Affectivity and Emotion module was decisive in this regard, as it integrated facial recognition games, environmental sounds, and musical sequences associated with basic emotions (joy, calm, surprise). These elements acted as symbolic mediators of affectivity, fostering the development of emotional awareness and behavioral regulation. These findings are supported by evidence from Godsk and Møller (2025), who demonstrate that the use of educational technologies mediated by positive emotions significantly enhances self-efficacy and persistence in complex tasks, especially when associated with symbolic rather than competitive rewards.

In addition, recent studies in emotional neuroeducation indicate that multimodal processing of affective stimuli strengthens cortico-limbic circuits related to intrinsic motivation and emotional control (Haghighi et al., 2023).

From a psychogenetic standpoint, autonomy is understood as the stage in which the subject ceases to depend on external impulses and begins to organize their own conduct, guided by internally constructed goals and meanings. The progress observed in this study suggests that the digital tool functioned as a mediating instrument, allowing students to gradually internalize criteria for self-assessment and self-management.

Interpretative Synthesis

The three analyzed axes—attention, motor coordination, and autonomy—indicate that the application successfully fulfilled its role as a theoretical-practical transposition of Psychogenetics into the technological field, demonstrating that the “dynamic steps” formulated by Xavier Jr. can be effectively translated into interactive environments without conceptual loss.

Quantitatively, the observed improvements (22%, 68%, and qualitative reports of autonomy) suggest educational effectiveness, even within a limited sample. Qualitatively, the main advancement lies in the internal coherence among theory, practice, and observation: each behavioral progress observed could be mapped onto one of the developmental levels predicted by Educational Psychogenetics.

As Luckin (2018) affirms, truly educational technologies “do not replace the teacher but expand the learner’s capacity to become aware of their own learning process.” Thus, the developed application is not presented as a mere training tool but as a formative device that enables the emergence of consciousness through sensory, cognitive, and emotional interaction.

Conclusion

This research investigated the application of the Educational Psychogenetics theory developed by Fr. Joaquim Ferreira Xavier Júnior, sjr., in the creation of an inclusive digital application aimed at the development of neurodivergent students. Grounded in the idea that learning results from the interaction between emotion, cognition, and motor activity, the study sought to translate the “dynamic steps” of Psychogenetics into an interactive and adaptive environment, integrating games, musical activities, tactile stimuli, and progressive challenges. The tool was developed by high school students under the guidance of teachers and researchers, consolidating a model of pedagogical co-creation that brought together theory, technology, and youth protagonism.

Over three months of implementation, the application demonstrated significant improvements in sustained attention (22%), fine motor coordination (68%), and emotional and cognitive autonomy among participants. Qualitative data revealed greater engagement, focus, and tolerance to frustration, confirming the hypothesis that technology, when guided by solid psychopedagogical foundations, can function as a mediating instrument for integral development. The results corroborate recent studies (Moura et al., 2022; Navas-Bonilla et al., 2025) that highlight the role of personalized technologies in enhancing neuroplasticity and adaptive learning for students with ASD and ADHD.

It is concluded that educational innovation lies not merely in the adoption of digital tools but in the integration between theory and humanizing practice. Psychogenetics proved to be a framework capable of guiding the ethical and pedagogical design of inclusive technologies, contributing to teacher training policies and the democratization of access to meaningful

learning. The psychogenetic educational inclusion application, by articulating science, art, and spirituality, demonstrates that the future of education lies in humanity's ability to use technology as an extension of both mind and heart—transforming diversity into formative potential.

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Contact email: waldirsm@ufrj.br