

ICS EXCHANGE 2026

INCLUSION, COMMUNICATION AND SOCIAL ENGAGEMENT

Atti di convegno - Book of abstract

A cura di Giusi Antonia Toto • Pierpaolo Limone • Martina Rossi



Università di Foggia

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INTRODUZIONE

La produzione scientifica contemporanea è attraversata da una crescente esigenza di riflessione critica sui processi di trasformazione che interessano i sistemi educativi, comunicativi e sociali, in un contesto in cui la digitalizzazione, la sostenibilità e l'inclusione si configurano come assi strutturali e interdipendenti del progresso umano e organizzativo. È all'interno di questo quadro di riferimento che si colloca la terza edizione della ICS Exchange Conference, tenutasi a Foggia e Trani nei giorni 10, 11 e 12 giugno 2026, il cui Book of Abstracts raccoglie oltre cento contributi scientifici provenienti da studiosi, ricercatori e professionisti di diversa provenienza disciplinare e geografica.

L'evoluzione del numero dei contributi presentati riflette la crescente rilevanza scientifica dell'iniziativa: dalle 26 presentazioni della prima edizione, alle 40 della seconda, fino a superare la soglia dei cento contributi in questa terza edizione. Tale progressivo incremento testimonia la vitalità della comunità accademica che riconosce nella ICS Exchange un luogo autentico di confronto e di avanzamento della ricerca. Il conferimento di tale ampiezza di contributi testimonia la solidità e la rilevanza assunta dalla conferenza nel panorama scientifico internazionale, configurandosi come un forum accademico di confronto interdisciplinare volto ad analizzare e interpretare le tensioni epistemologiche, metodologiche e applicative che caratterizzano i processi di apprendimento, comunicazione e partecipazione nella contemporaneità. La conferenza si articola in sei aree tematiche principali – *Psychology, Education, Inclusion, Social Engagement and Communication, Serious Games and Gamification, Learning and Technologies* – che rappresentano differenti prospettive di indagine sul rapporto fra conoscenza, innovazione e

società. La struttura delle tracks riflette un approccio che privilegia la connessione tra teorie della mente, pratiche educative e tecnologie digitali, nel tentativo di delineare nuovi modelli formativi orientati alla persona, alla comunità e al contesto. La Psychology track raccoglie lavori che esplorano i fattori cognitivi, affettivi e motivazionali connessi alle esperienze di apprendimento e alla socialità digitale, analizzando i processi di adattamento e i fenomeni di vulnerabilità emergenti. La Education track si concentra su metodologie, curriculum e politiche educative finalizzate all'innovazione della didattica e alla formazione continua. La Inclusion track approfondisce la costruzione di contesti formativi accessibili e la promozione di pratiche inclusive nella scuola e nella società. Nell'area Social Engagement and Communication si esaminano i processi di interazione e di costruzione sociale della conoscenza nei nuovi ambienti comunicativi, con specifico riferimento al ruolo dei media digitali e alle dinamiche partecipative online. La Serious Games and Gamification track propone studi empirici e teoretici sulle potenzialità delle metodologie ludiche nei processi di apprendimento, sviluppo di competenze e inclusione. Infine, la Learning and Technologies track approfondisce l'uso di tecnologie abilitanti, strumenti digitali e ambienti immersivi al servizio della didattica, della formazione personalizzata e dell'apprendimento permanente. In coerenza con le precedenti edizioni, l'edizione 2026 della ICS Exchange Conference si distingue per il suo orientamento scientifico integrato: essa promuove un terreno comune di ricerca che coniuga approcci psicologici, educativi e tecnologici, nella prospettiva di un sapere capace di interpretare i cambiamenti socio-culturali e di trasformarli in processo formativo e di cittadinanza scientifica. I contributi qui raccolti non rappresentano semplicemente la documentazione di un evento, ma delineano un corpus scientifico articolato, che testimonia l'impegno della comunità accademica nel costruire paradigmi interpretativi fondati su evidenze empiriche, riflessione teorica e responsabilità epistemica. Essi configurano l'ICS Exchange

come un laboratorio internazionale di ricerca, nel quale l'incontro tra discipline diviene condizione per la produzione di conoscenza innovativa e socialmente rilevante. Desidero esprimere un sentito ringraziamento agli autori dei contributi, ai revisori e ai membri del Comitato Scientifico, il cui lavoro rigoroso ha permesso di garantire la qualità e la coerenza scientifica dei materiali raccolti. Il loro contributo testimonia una comune tensione verso l'eccellenza e la continuità della riflessione sulle intersezioni tra educazione, scienze cognitive, tecnologie e società. Questo volume intende dunque offrire una sintesi significativa dello stato dell'arte e, al contempo, porre le basi per ulteriori linee di ricerca, in un orizzonte teorico e pratico che riconosce nella multidisciplinarietà e nella sostenibilità i fondamenti di una conoscenza realmente generativa.

Giusi Antonia Toto

LEVEL UP YOUR MOTIVATION: THE GAMIFIED TEXTBOOK ARCHITECTURE AS A TOOL FOR INCLUSION, EMOTIONAL REGULATION, AND SKILLS DEVELOPMENT

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1. Introduction

In the contemporary higher education landscape, students frequently experience a rapid decline in motivation and the onset of boredom when engaging with complex academic texts. This phenomenon represents a significant barrier to learning, particularly for students with special educational needs (SEN) or attentional difficulties, often leading to procrastination or drop-out. The theoretical and practical gap addressed by this research lies in the transition from gamification understood as an “external platform” (points, badges, leaderboards applied to a course) to the structural gamification of the text itself. Transforming the editorial model into a “book-as-a-videogame” allows boredom to be addressed not as a learner’s limitation, but as an alarm signal to be managed through emotional self-regulation strategies (Gross, 2015). In a digital and inclusive context, it is essential to develop tools that do not merely transmit content but guide the student in acquiring transversal competencies (soft skills) such as resilience, self-regulation, and cognitive reappraisal (Pekrun et al., 2002).

2. The study

This study forms part of a broader research project aimed at experimenting with innovative teaching approaches in the field of higher education;

it stems from the need to re-establish the link between academic reading and intrinsic motivation in an educational context that is deeply influenced by digital culture but often lacks the interactive tools required for sustained engagement (Buckley & Doyle, 2016). From this perspective, the study explores the educational potential of gamified textbooks through the lens of emotional regulation, to understand how narrative texts can serve as educational tools capable of stimulating processes of interest enhancement and the internalization of self-regulatory strategies (Sansone & Thoman, 2005). The textbook is proposed as a space for active interaction, a place where theoretical concepts are transformed into “tutorials” and practical activities into “Challenges” and “Boss Fights”, enabling the reader to develop forms of metacognitive and reflective thought. The educational intervention aims to enhance the academic text as a tool for inclusive learning, capable of educating the student’s emotional awareness and promoting the construction of meaning through a gameful experience (Deterding et al., 2011)

3. Objective of the study

The main objective is to investigate how students construct motivational representations based on gamified narrative language, and to what extent these game elements function as cognitive and affective mechanisms for constructing meaning and sustaining engagement (Jiménez-Valverde et al., 2025). The research also aims to highlight the role of emotional self-regulation as a cross-curricular skill that enables the cognitive dimension of reading to be linked to metacognitive reflection and the development of transversal competencies. From this perspective, the gamified textbook is considered not merely as a subject of academic study, but as an educational space in which the reading process, through its interactive power, becomes an opportunity for knowledge and personal growth.

4. Methodology and instruments

The research adopts an exploratory methodological approach and is based on the integration of qualitative and quantitative tools within a mixed-methods framework. The sample consists of university students (e.g., preservice teachers or educators) who are already accustomed to guided reading and metacognitive reflection on academic texts. They were given a structured digital environment designed to collect data on emotional perception, the subjective understanding of gamified challenges, and awareness of the process of constructing interest. The quantitative data were collected through the Experience Sampling Method (ESM) integrated as a game mechanic ("internal radar") to measure boredom and interest levels in real-time, and the Intrinsic Motivation Inventory (IMI) administered in the post-test (Hektner et al., 2007; Ryan & Deci 2000). The quantitative data were analyzed descriptively, whilst the open-ended responses (short final reports) underwent thematic analysis with the aim of identifying the main self-regulatory categories that emerged – such as the "Translator", the "Time keeper", and the "Populariser" strategies – and of exploring their educational significance. The methodological approach adopted favours an interpretative perspective that recognises the centrality of the reader's subjectivity in the elaboration of motivational meanings generated by the interaction between the reader and the gamified text.

5. Results and discussion

Initial findings suggest that most of the students involved tend to actively engage with the content of gamified texts, attributing a fundamental role to cognitive reappraisal in the processes of comprehension and emotional regulation. The most frequent strategies are linked to personal passions and time-based challenges and often take on a metacognitive significance. The act of 'hacking' the reading experience takes the form of an integrated cognitive experience, capable of activating cognitive, emotional and value-based dimensions. This demonstrates that

academic reading, when mediated through gamified education practices, can foster the development of complex self-regulatory skills, emotional sensitivity and an awareness of the learning process among students. The integration of Learning Analytics offers crucial opportunities to intercept special learning needs and support inclusive education (Toto, 2019). Furthermore, the synergy between assistive technologies, digital communication, and multidisciplinary approaches is fundamental for psycho-educational innovation (Toto, 2020; Toto et al., 2025). The data therefore suggest the need to rethink textbook design as an educational process that values structural gamification and its educational potential.

6. Conclusion

This research confirms the value of the narrative-gamified approach as a formative and innovative perspective for contemporary higher education. The academic text, interpreted through the lens of game design, proves capable of connecting emotion, thought and knowledge, fostering authentic and participatory learning processes (Kapp, 2012). Reading complex texts thus amounts to learning a way of self-regulating, of inhabiting challenges and of recognising in them a universal language of skills and meanings. From this perspective, the gamified textbook does not belong solely to the instructional heritage, but becomes a space for personal and collective growth, a tool for metacognitive reflection and for the formation of the self-regulated learner.

Keywords

gamification; narrative learning; learning analytics; inclusive education; emotional regulation.

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FRANKENSTEIN, BETWEEN A DIABOLICAL VISION AND THE PEDAGOGY OF PROGRESS

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Abstract

Although more than sixty years have passed since Umberto Eco's (1964) categories of "apocalyptic" and "integrated" intellectuals entered Western thought, they continue to retain substantial relevance, as they represent one of the most effective metaphors for describing humanity's two opposing attitudes toward scientific and technological progress. From the widespread diffusion of the Internet to reflections on the educational potential of the Metaverse, and up to the current debate on artificial intelligence – just to mention a few examples with direct implications for pedagogy – confidence in innovation consistently coexists with fear of the unknown.

This cultural confrontation between apocalyptic and integrated perspectives has re-emerged forcefully in recent years, particularly within university classrooms, where both undergraduate students and prospective teachers enrolled in specialization programs increasingly call for convincing answers regarding the future of education – and of humanity itself – in a world ever more shaped by technological development. From this perspective, artificial intelligence represents only the most recent manifestation of a long-standing tension between trust and suspicion toward technological progress (Alwaqdani, 2025).

The dialectic of fear and trust toward the new and the unknown, however, is by no means a novelty of the twenty-first century. On the contrary, it is deeply rooted in human experience, especially since the

late eighteenth century, when technology began its slow and inexorable diffusion into everyday life (Russell, 1981).

The aim of this contribution is therefore to trace, within the history of science and technology, examples that demonstrate how recurring themes – namely fear and unconditional trust – are intrinsically linked to modern humanity and to the very idea of progress. Through a critical reading of the works of several scientists of the period and an examination of writings that contributed to the so-called “pedagogy of innovation” (Dolza, 2008), the paper explores the historical genesis of both illusion and fear surrounding scientific and technological advancement, adopting a historical-literary comparative methodology. One of the most emblematic examples in this regard is Mary W. Shelley’s *Frankenstein*, published in 1818. The insights drawn from this nineteenth-century analysis are intended to inform contemporary pedagogical practice and teacher training, offering historical grounding for educators navigating present-day debates on technology and innovation in the classroom.

The notion that science and technology might, in the near future, even replace nature itself (Florescu, 1996) by simulating living phenomena was not confined to the artistic sphere or to collective imagination. Experiments involving fluids, animal electricity (Galvani, 1791), and automata fostered – between the late eighteenth century (Hille, 2025) and the first decades of the nineteenth century (Magoun, 2019) – the illusion, even among some scientists, that life could be controlled and reproduced. This recurring narrative, widely echoed in literary and cinematic production throughout the nineteenth and twentieth centuries, has tended to portray science, on the one hand, as a genuinely diabolical art and, on the other, technological enterprise as an attempt to alter the purity of humanity and nature – an interpretative framework that continues to resonate within contemporary pedagogical debates on artificial intelligence.

Keywords

Frankenstein; Galvani; automata; animal electricity; pedagogy of innovation; artificial intelligence

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PSYCHOLOGICAL CORRELATES OF HIKIKOMORI SYNDROME: THE ROLE OF PERSONALITY TRAITS, DEPRESSION, AND ANXIETY IN A SOUTHERN ITALIAN SAMPLE

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Abstract

1. Background

Hikikomori Syndrome (HS), derived from a Japanese term meaning “to withdraw” or “to stand aside”, refers to a clinical condition characterized by prolonged social withdrawal, with affected individuals remaining isolated in their homes for at least six months (Kato et al., 2019). Although initially described in Japan, mounting evidence supports its presence worldwide. HS has also been conceptualized as a form of “modern-type depression” (MTD) and is frequently associated with symptoms of depression and anxiety. Furthermore, it shows overlap with social anxiety disorder and several personality disorders, including avoidant, paranoid, schizotypal, dependent, schizoid, antisocial, borderline, and narcissistic traits (Teo et al., 2015).

2. Methods

This observational study examined a sample of 89 individuals (60% female, 40% male) residing in Southern Italy, aiming to investigate the association between depressive and anxiety symptoms, Cluster C personality traits,

and HS. Participants were divided into two groups based on HQ-25-I scores: Hikikomori-ON ($n=24$, HQ-25-I >53.5 , DS=7.80) and Hikikomori-OFF ($n=65$, HQ-25-I <24.2 , DS=9.76). Participation was voluntary, and informed consent was obtained from all subjects. Data were collected via an online survey administered through Google Forms, including the following psychometric instruments: BDI-II, NEO-FFI, Liebowitz Social Anxiety Scale, and HQ-25-I. Anonymity and data confidentiality were ensured. Statistical correlation analyses were conducted using the Jamovi software.

3. Results

Contrary to initial hypotheses, social anxiety did not emerge as a significant predictor of HS ($p=0.276$ for the ON group). However, individuals in the Hikikomori-ON group exhibited a trend toward higher levels of neuroticism ($r=0.344$, $p=0.100$) and significantly lower levels of extraversion ($r=-0.498$, $p=0.013$), suggesting increased emotional vulnerability and a tendency toward social disengagement. Additionally, introversion and problematic internet use were identified as key factors in the maintenance of HS, supporting the hypothesis that social withdrawal may function as a maladaptive coping strategy in response to social stress.

Results show that Hikikomori syndrome in the sample population from southern Italy exhibits statistically significant correlations only in certain psychological domains and differs from classic anxiety and depressive disorders both clinically and phenomenologically (Orsolini, L., et al., 2024).

4. Discussion

This study has a couple of limitations. Firstly, the cross-sectional design does not allow for causal conclusions to be drawn. The relatively small sample size represents a further limitation of the study and may affect the statistical significance of the correlations. Moreover, hikikomori syndrome is strongly influenced by the socio-cultural environment: the findings may differ in other European or Asian contexts.

However, from a clinical perspective, these findings highlight the need for multidisciplinary interventions, including family psychoeducation, cognitive-behavioral therapy, and digitally mediated approaches aimed at promoting gradual social re-engagement. In particular, behavioral activation and online therapeutic interventions appear to be promising strategies to facilitate social reintegration.

5. Conclusion

Overall, the present study supports the conceptualization of HS as a distinct clinical condition, characterized by specific psychological features that require tailored and innovative intervention models (Bonnaire, C., & Roignot, Z., 2023). Future longitudinal research is warranted to better understand the developmental trajectories of HS and to inform effective prevention and treatment strategies.

Keywords

Hikikomori Syndrome, Social Withdrawal, Depression, Anxiety, Personality Traits

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THE MULTIMEDIA ARTIST AS A PROACTIVE AGENT OF MEDIA EDUCATION: A THEORETICAL FRAMEWORK AND PILOT CALIBRATION OF NARRATIVE COORDINATES

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Abstract

In the contemporary post-digital landscape, defined by a chronic “iconic overload” and the pervasiveness of algorithmic patterns, visual stereotyping risks limiting the agency of young citizens (Panciroli & Rivoltella, 2025). This paper proposes a paradigm shift in Media Education (ME): the multimedia artist, trained in New Technologies of Art, acts as a proactive agent who co-creates educational models by inhabiting the “in-between” space of A/r/tography (Irwin R, 2013). Moving beyond the instrumental use of technology, the study identifies Digital Storytelling (DST) as a complex communicative system capable of bridging the gap between artistic creation and educational inquiry (De Rossi M, 2014).

The research goal is to define a system of stable narrative coordinates that allow the audiovisual text to function as a device for textual redefinition and social mediation. Drawing on the “grammar for digital storytelling” (Talarico M, 2021), the paper investigates coordinates such as the identification of the point of view (self-narration), the definition of the dramatic question, and the management of conflict and balance within the narrative (Virzì M, 2015).

Methodologically, the study adopts a qualitative practice-based approach within the A/r/tography framework, where the researcher’s professional experience as a scenarist allows for a “living inquiry” (Springgay S, 2005). The pilot project “CostellAzioni” (Cooperativa MOMO, 2023/24) is discussed to clarify the theoretical hypothesis, in involving workshops in five youth aggregation centers (Third Spaces). The research combined workshop observation,

analysis of audiovisual outputs, and reflective documentation. Preliminary observations suggest that point of view, dramatic question, and conflict management recur as the most stable narrative coordinates across the pilot workshops. By mapping these bridge-points, the study provides a framework for enhancing multimodal literacies, enabling students to transition from passive consumers to reflexive digital producers, thereby fostering a critical and agentive digital citizenship in the post-digital era (Wuthnow J, 2023).

Keywords

Multimedia arts; a/r/tography; digital storytelling; new literacies; media education.

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THE POLYBIUS SQUARE CIPHER: A SEMIOTIC MEDIATOR FOR INTRODUCING THE CARTESIAN PLANE

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1. Introduction

The growing emphasis on inclusive technologies and mathematics education has prompted significant strategic measures, including the EU STEM Education Strategic Plan and Goal 4 of the 2030 Agenda. Technology in education has established itself as a powerful semiotic mediator, capable of introducing alternative approaches and supporting students in overcoming cognitive difficulties [1].

A persistent challenge in primary mathematics is the transition from informal spatial reasoning to the abstract notation of the Cartesian plane: students are typically asked to memorise a convention before they have any experiential anchor for it. Following the Mathematics Laboratory approach and the Theory of Semiotic Mediation, this contribution proposes and empirically tests an alternative pathway – one in which the Polybius Square, a cryptographic tool from classical antiquity, functions as a concrete, motivating bridge towards the coordinate plane and modern analytic geometry.

2. The Polybius square cipher as a semiotic mediator for the Cartesian Plane

We report on an experimental learning laboratory conducted with one fifth-grade class (N = 20 students, aged 10–11) in a primary school in Perugia, across three sessions of approximately 90 minutes each. The intervention articulates three progressive phases: (1) encoding and decoding messages with the paper Polybius Square, building an informal, embodied familiarity with grid coordinates; (2) explicit introduction of Cartesian notation – comparing analogies and differences between the cipher grid

and the coordinate plane; (3) exploration of a purpose-built interactive web application, implemented in p5.js, in which each letter is plotted as a point on a Cartesian plane and animated projection lines dynamically trace the reading of (x, y) coordinates onto the axes. Data were collected through participant observation, written worksheets, and a purpose-designed pre/post instrument (10 items) assessing coordinate identification accuracy, ordered-pair notation, and axis orientation. The web application operates as a digital semiotic mediator [1]: by rendering the cipher as an interactive Cartesian plane, it makes the structure of ordered pairs perceptually immediate and gesturally accessible – functioning, in Latour’s [2] terms, as a non-human actant that delegates to the artefact the task of making the mathematical structure visible and manipulable – and enabling students to experience coordinates as a lived, tool-mediated reality rather than an abstract convention, in Peirce’s sense [3].

Grounded in Vygotsky’s theory of mediated action [4] and the Theory of Semiotic Mediation [1], the study analyses how students progressively internalise the logic of ordered pairs through repeated engagement with the artefact – first as a cipher device, then as a geometric model. As demonstrated in related work on virtual mathematical mediators [5], the digital environment supports distributed cognition [6]: knowledge is co-constructed through dynamic interaction with the tool, not transmitted as a static definition. Pre/post instrument results reveal a substantial learning gain: correct coordinate identification rose from 38% to 82% of responses (normalised gain $g = 0.71$, high range by Hake’s criterion). Worksheet analysis documents a progressive shift from informal column/row language to standard (x, y) notation, fully consolidated by Phase 3: all 20 students spontaneously applied Cartesian pairs when encoding messages in the web application, without prompting. The greatest conceptual gain was recorded on items targeting ordered-pair asymmetry – the understanding that $(3, 1)$ and $(1, 3)$ denote distinct points, a notoriously persistent misconception at this level. These findings confirm that the Polybius Square operates as a

privileged semiotic mediator: high normalised learning gain, spontaneous adoption of Cartesian notation, and heightened collaborative discourse together provide empirical evidence that a three-phase embodied laboratory, anchored in the history of mathematics and supported by an interactive web artefact, effectively transforms the transition from cryptographic grid to coordinate plane into an inclusive, discovery-driven learning path [7].

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DIGITAL FINANCIAL MODELLING AS A TOOL FOR INCLUSION AND SOCIAL SUSTAINABILITY IN STEM

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Abstract

This study explores how digital literacy in financial modelling can act as a bridge to enhance student engagement, diversity, and inclusion in STEM education, while repositioning financial mathematics as a tool for social sustainability. The research addresses two main questions: (RQ1) In what ways can digital financial modelling foster student engagement, diversity and inclusion in STEM subjects? (RQ2) To what extent can a financial mathematics lab shift students' perspectives from viewing finance as a tool for personal gain to a mechanism for social equity and sustainability?

The study involves 47 grade 12 students from an Italian high school attending an extracurricular technology-enhanced laboratory activity in 2024/2025. Students worked in groups on financial modelling, data analysis, and open-ended problem-solving tasks such as investment simulations in a computer supported learning environment (Matteucci et al., 2024; Perrotta et al., 2024). The activity design is grounded in socio-constructivist perspectives (Vygotsky, 1978; Radford, 2016), emphasizing knowledge co-construction through interaction, dialogue, and shared meaning-making. The choice of a laboratory setting is strategic, serving as a primary space for students to encounter interdisciplinary problems and build collective knowledge through authentic collaborative practice (Funkhouser et al., 2018). Consistent with Wing (2014), this study posits

that collaborative, computational learning environments are vital for fostering inclusion and reducing participation gaps in mathematics-related pathways. Our focus lies in designing tasks and group structures that mandate active participation, ensuring that diverse student perspectives and prior experiences are central to the learning process.

Data has been collected through pre- and post-intervention ad-hoc questionnaires based on 5-point Likert scales and open-ended qualitative questions measuring perception of financial, mathematics identity and gender stereotypes. Inferential analysis, conducted via paired t-tests and Wilcoxon signed-rank tests on matched samples, revealed a statistically significant improvement in students' perception of extracurricular laboratory activities, with mean scores increasing from 3.47 to 3.83 ($t=-2.13$, $p\text{-value}=0.041$). Quantitative results were corroborated by qualitative feedback, which highlighted a distinct transition from passive-traditional learning models to active-dynamic ones. Furthermore, students demonstrated high overall interest in the topics covered (post-module mean: 4.20/5.00) and an increased awareness of the social utility of finance as a tool for reducing social inequalities and promoting economic sustainability (mean = 3.87/5.00). By engaging in financial modelling, students directly confronted issues of risk, inequality, and sustainability, ultimately developing a more critical and socially responsible understanding of the financial sector. This shift is reflected in students' language, which increasingly incorporates notions of responsibility, long-term impact, and collective well-being when discussing financial decisions. Furthermore, active participation, confidence and mathematical sensemaking were significantly enhanced using custom-built Excel spreadsheets. These advanced digital instruments allowed students to engage in real world data analysis and financial simulations, fostering a more inclusive learning environment, where mathematics constitutes a practical tool for interpreting and addressing real-world financial and social issues. Importantly, digital environments also functioned as medi-

ating artefacts that facilitated communication, negotiation, and shared problem-solving within groups, making mathematical reasoning more accessible to all learners. Our results support the conference theme by illustrating how digital, laboratory-based approaches enable collaborative problem-solving and sensemaking. Specifically, the data indicates that financial modeling, when framed around social relevance, can contribute to reshape students' mathematical identities, particularly for those who might not traditionally see themselves as "STEM-oriented". This research underscores a powerful synergy between digital literacy and inclusive pedagogy; by recontextualizing financial mathematics within a framework of equity and sustainability, educators can deepen mathematical sensemaking and cultivate a generation of socially conscious citizens. While results are promising, this pilot study is limited by its sample size and single-school context. Future research will address these constraints through a multi-year, multi-school comparative study to enhance the transferability of the results and validate the impact of this pedagogical framework.

Keywords

Digital financial modelling; Social sustainability; Technology-enhanced laboratory; Mathematical identity.

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AN EXPLAINABLE SENTIMENT ANALYSIS MODEL FOR STUDENT FEEDBACK SYSTEMS

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Abstract

The rapid expansion of online and blended learning environments has significantly increased the dependence on textual student feedback to evaluate teaching effectiveness and learning quality. While sentiment analysis techniques have been successfully applied to analyze such feedback, most existing approaches operate as black-box models, offering limited transparency and interpretability to educators. This lack of explainability restricts trust and reduces the practical adoption of AI-driven educational analytics. This paper proposes an Explainable Sentiment Analysis model for student feedback systems by extending deep learning-based sentiment analysis with explainable artificial intelligence (XAI) techniques. Building upon prior research integrating sentiment analysis into Learning Management Systems (LMS) (Almutairi, 2025), the proposed framework combines contextual word embeddings, bidirectional Long Short-Term Memory (BiLSTM) networks, attention mechanisms, and post hoc explanation methods such as SHAP and LIME. The model not only classifies student feedback into sentiment categories but also provides interpretable explanations highlighting influential words and phrases. This approach enhances transparency, supports informed

decision-making by educators, and improves the reliability of sentiment-aware educational systems.

Index Terms – Sentiment Analysis, Explainable AI, Student Feedback, Learning Management Systems, Natural Language Processing, SHAP, LIME, BiLSTM

1. Introduction

The adoption of online education platforms has accelerated dramatically in recent years, particularly following the COVID-19 pandemic, which compelled millions of students and educators worldwide to transition abruptly to remote learning environments (Almutairi, 2025). Learning Management Systems (LMS) have become the primary medium for delivering instructional content, conducting assessments, and collecting student feedback. In traditional classroom settings, instructors naturally rely on a combination of verbal communication and non-verbal cues – including facial expressions, gestures, and eye contact – to assess student engagement and comprehension in real time. These non-verbal indicators are largely absent in online learning environments, creating a significant communicative gap between students and instructors (Almutairi, 2025).

As a result, textual feedback submitted through LMS platforms has become a critical and often primary source of information for understanding student experiences, emotional states, and learning progress. Manually analyzing this feedback at scale is both time-consuming and subjective, motivating the use of automated sentiment analysis techniques. Sentiment analysis, a well-established subfield of Natural Language Processing (NLP), aims to identify emotional polarity expressed in textual data – typically positive, negative, or neutral sentiment (Vidya et al., 2024). Recent advances in deep learning, particularly Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, and attention mechanisms, have significantly improved sentiment clas-

sification performance by effectively capturing contextual and sequential dependencies in text.

Despite these advances, a fundamental challenge persists: the majority of high-performing deep learning models function as opaque black boxes, providing no explanation of why a particular sentiment label was assigned. In educational contexts, this lack of interpretability is especially problematic. Educators cannot be expected to act upon AI-generated assessments they do not understand or cannot verify. The absence of explainability undermines trust, limits actionability, and raises ethical concerns around algorithmic decision-making in sensitive academic environments (S. Baskar, 2025; Badawi, 2026).

Explainable Artificial Intelligence (XAI) has emerged as a prominent research field aimed at addressing these transparency deficits. Techniques such as SHAP (SHapley Additive exPlanations) and LIME (Local Interpretable Model-Agnostic Explanations) provide post-hoc explanations by identifying and quantifying the contribution of individual input features to model predictions (Salih et al, 2012; Ribeiro et al. 2016). When applied to text classification, these methods highlight the specific words and phrases that most influence a sentiment prediction, offering educators granular, human-understandable insights into model behavior.

This paper addresses the interpretability gap by proposing an Explainable Sentiment Analysis (ESA) framework for student feedback in LMS environments. The proposed system integrates a BiLSTM-based deep learning model enhanced with attention mechanisms and augmented with SHAP and LIME post-hoc explainability modules. The remainder of this paper is structured as follows: Section II reviews related work; Section III presents the proposed system overview; Sections IV and V describe data preprocessing and the model architecture; Section VI details the explainability mechanisms; Section VII discusses implications; and Section VIII concludes with future directions.

2. Related work

A. Sentiment Analysis in Educational Contexts

Sentiment analysis has been widely studied across diverse domains, including social media monitoring, healthcare feedback, and e-commerce review analysis. Within the educational domain, its application to student feedback, course evaluations, and online discussion forums has attracted growing research interest. Early work relied largely on lexicon-based methods and traditional machine learning classifiers such as Support Vector Machines (SVM), Naïve Bayes, and Logistic Regression. While these approaches offer computational simplicity and interpretability, they frequently fail to capture complex linguistic phenomena such as negation, sarcasm, contextual irony, and mixed sentiments that are commonly observed in student-generated feedback (Vidya et al., 2024).

Almutairi (2025) proposed a comprehensive deep learning-based sentiment analysis framework integrated directly into Learning Management Systems to analyze student feedback at scale. The study utilized word embeddings, bidirectional LSTM networks, and attention mechanisms trained on the publicly available RateMyProfessor dataset. By comparing the deep neural network model against a logistic regression baseline, the study demonstrated that the RNN-based model achieved superior accuracy (80% vs 77%), precision (83% vs 77%), recall (85% vs 76%), F1-score (0.84 vs 0.77), and AUC (0.88 vs 0.86). Critically, this work highlighted the inadequacy of traditional models in handling sequential dependencies and nuanced mixed-sentiment sentences – a limitation directly motivating the present work’s focus on explainability and contextual understanding.

(Vignesh et al. 2024) explored explainable sentiment analysis specifically for social media posts using attention mechanisms. Their study demonstrated that attention weights serve as an effective intrinsic interpretability tool, visually highlighting which tokens drive sentiment predictions. Ren et al. developed an aspect-level sentiment analysis system

for automatic scoring of student feedback intended to support teaching evaluation, showing that fine-grained sentiment modeling at the aspect level provides significantly richer insights than document-level classification alone. Baskar (Baskar, 2025) conducted a systematic review of sentiment analysis techniques in educational contexts, identifying a recurring gap in the literature: the majority of high-performing models lack mechanisms to communicate their decision logic to non-technical stakeholders such as instructors and academic administrators.

B. Explainable AI for NLP Models

Explainable Artificial Intelligence (XAI) has emerged as a critical response to the widespread deployment of opaque deep learning models across high-stakes domains. (Lundberg and Lee, 2017) introduced SHAP, a unified framework grounded in cooperative game theory and Shapley values, which attributes each input feature's marginal contribution to a model's output in a theoretically consistent manner. SHAP provides both global model-level explanations – summarizing which features most influence predictions across the entire dataset – and local instance-level explanations, making it particularly well-suited to analyzing individual student feedback entries. (Ribeiro et al. 2016) introduced LIME, which generates local surrogate models to approximate a complex classifier's behavior in the neighborhood of a specific input instance. By perturbing input tokens and observing output changes, LIME identifies which words most influence a given prediction, providing fine grained, instance-level interpretability (Salih et al, 2012).

Salih et al. (Salih et al, 2012). provided a comparative analysis of SHAP and LIME across classification tasks, noting that while both methods offer complementary explanations, SHAP tends to provide more consistent global importance rankings, while LIME excels at producing intuitive local explanations for individual instances. In the educational domain specifically, (Badawi, 2026); demonstrated that integrating SHAP

and LIME with a CNN-based educational question classifier not only preserved predictive accuracy (88%) but also enabled educators to clearly identify the reasoning behind predictions – a finding that directly supports the approach proposed in the present work. Turkmen [6] reviewed 35 XAI studies in educational “ research from 2019 to 2024, confirming that SHAP and LIME enhanced models substantially improve teacher and student trust in AI-based tools, facilitating wider adoption in classroom settings. Despite this growing body of evidence, the application of XAI techniques specifically to sentiment analysis of free-form student LMS feedback remains an underexplored area, leaving a clear gap that the present paper addresses.

3. Proposed system overview

The proposed Explainable Sentiment Analysis (ESA) system is designed to automatically process student textual feedback collected through LMS platforms and deliver interpretable sentiment insights to educators. The system follows a modular, end-to-end pipeline encompassing five interconnected stages: data ingestion and preprocessing, feature representation, deep learning-based sentiment classification, post hoc explainability generation, and educator-facing visualization.

Figure 1 illustrates the high-level workflow of the proposed system. Raw student feedback text is first collected from the LMS and passed through a preprocessing pipeline that normalizes linguistic variations and removes noise. The cleaned and featurized text is then classified by a BiLSTM based deep learning model enhanced with attention mechanisms. Following classification, the explainability module applies SHAP and LIME to produce word-level importance attributions. Finally, an educator dashboard visualizes both the sentiment predictions and their explanations in an accessible, color-coded format.

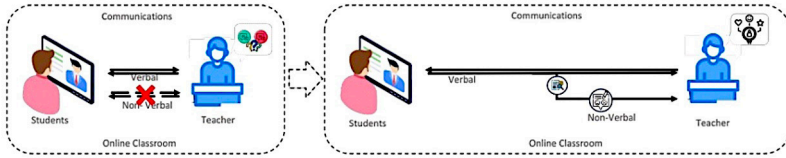


FIG. 1 – Overall workflow of the proposed explainable sentiment analysis system for student feedback.

Figure 2 provides a detailed view of the internal processing steps within the proposed pipeline, from raw text input through to the final explainable sentiment output delivered to educators.

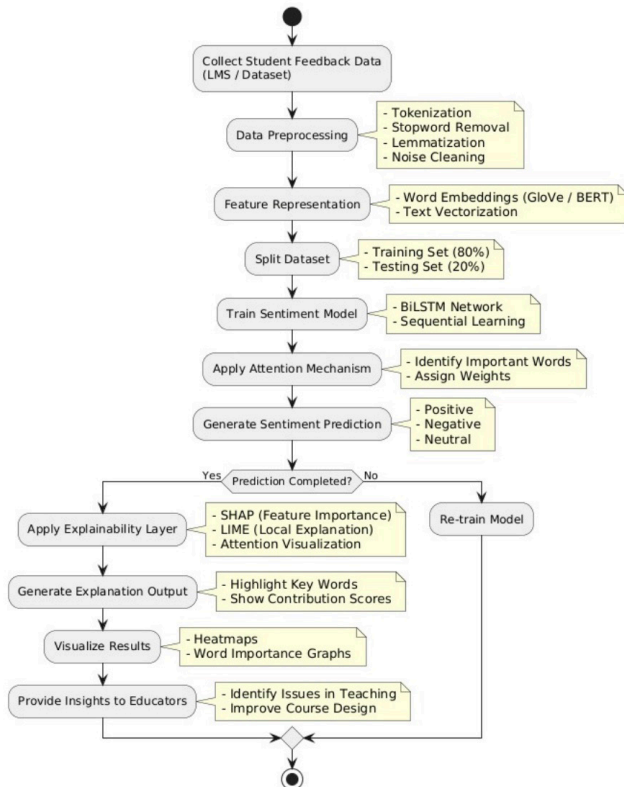


FIG. 2 – Detailed workflow of the proposed explainable sentiment analysis system.

A key design principle of the proposed system is the separation of the predictive and explanatory components. The BiLSTM model is trained and optimized independently to maximize classification performance.

The XAI modules are applied post-hoc, ensuring that the addition of explainability does not compromise predictive accuracy. This design allows the system to be adapted to different LMS platforms and feedback datasets without requiring architectural modifications to the core classification model.

4. Data preprocessing and feature engineering

A. Dataset

Following the methodology established by Almutairi [1], the proposed system is evaluated using the RateMyProfessor dataset, a publicly available collection of student reviews for instructors across diverse academic institutions in the United States (He, 2020). The dataset comprises textual comments alongside structured metadata including star ratings (1–5 scale), difficulty indices, and demographic markers. The star rating attribute serves as the primary proxy for sentiment labeling: ratings of 3.5 to 5.0 are classified as positive, 2.5 to 3.4 as neutral, and 1.0 to 2.4 as negative, consistent with RateMyProfessor’s official classification standards. After removing records with missing comment fields, the working dataset contains approximately 19,993 labeled feedback entries spanning 17,583 unique vocabulary tokens.

B. Preprocessing Pipeline

Data preprocessing plays a crucial role in improving both the performance and robustness of sentiment analysis models. Student feedback text commonly contains spelling errors, informal language, abbreviations, and irrelevant tokens. The preprocessing pipeline implemented in this work includes the following sequential steps.

Tokenization divides raw feedback text into individual word tokens, serving as the foundational step for all subsequent text processing operations.

Stop-word removal eliminates high-frequency words that carry minimal semantic content relevant to sentiment classification, such as articles, conjunctions, and prepositions (e.g., “the”, “an”, “in”). This step was performed using the NLTK library [13], consistent with the approach of (Almutairi, 2025).

Lemmatization reduces each word token to its canonical base form, grouping inflected variants of the same lexeme (e.g., mapping “grading”, “graded”, and “grades” to the common root “grade”). This reduces vocabulary dimensionality and improves generalization across unseen feedback. Lemmatization was performed using the WordNetLemmatizer from the NLTK library (Natural Language Toolkit, 2023).

C. Feature Extraction and Class Balancing

Following preprocessing, the TF-IDF (Term Frequency–Inverse Document Frequency) method is applied to convert the cleaned textual data into numerical feature vectors. TF-IDF is particularly effective in this context because it down-weights common terms that appear uniformly across all sentiment classes while amplifying terms that are discriminative for specific sentiment categories (Almutairi, 2025). A chi-squared statistical test is subsequently applied to select the most informative vocabulary subset; based on chi-squared score analysis, a vocabulary of 5,000 tokens is selected as providing the most stable and representative feature space.

The original RateMyProfessor dataset exhibits a pronounced class imbalance, with positive feedback substantially outnumbering negative instances. To prevent the model from developing biased predictions that favor the majority class, the Synthetic Minority Oversampling Technique (SMOTE) is applied to the training data. SMOTE generates synthetic minority class instances by interpolating between existing sam-

ples, producing a balanced dataset that supports fair learning across all sentiment classes and improves recall, F1-score, and AUC metrics for the minority class (Almutairi, 2025).

5. Model architecture

A. Embedding Layer

The model begins with an embedding layer that maps each input vocabulary token to a dense, low-dimensional vector representation. Unlike one-hot encodings, dense word vectors capture semantic relationships between terms, allowing the model to generalize across semantically similar words. In the proposed architecture, GloVe pre-trained embeddings are employed to initialize the embedding layer, providing a strong semantic prior particularly effective for domain-general English text [1]. The use of pre-trained contextual embeddings significantly reduces the data requirements for training and improves representation quality for low-frequency domain specific terms appearing in student feedback.

B. Bidirectional LSTM Layer

The embedding outputs are processed by a Bidirectional LSTM (BiLSTM) layer, which extends the standard LSTM architecture by processing each input sequence in both the forward (left-to-right) and backward (right-to-left) directions simultaneously. This bidirectional processing is critical for sentiment analysis because sentiment polarity in student feedback is frequently determined by words appearing at any position in the sentence, including modifiers and negations that may precede or follow the primary sentiment-bearing term. As demonstrated in (Almutairi, 2025), bidirectional LSTM networks substantially outperform unidirectional recurrent models in capturing long-range contextual dependencies within feedback sentences.

LSTM units address the vanishing gradient problem inherent in standard RNNs through their gating mechanisms – input gate, forget

gate, and output gate – which selectively retain or discard information across sequence time steps. This enables the BiLSTM to maintain relevant contextual information over long feedback passages without degradation (Lipton, 2015).

C. Attention Mechanism

An attention mechanism is applied to the BiLSTM output representations. Rather than compressing the entire input sequence into a single fixed-length context vector, the attention layer computes a weighted sum of all hidden states, assigning higher weights to tokens that are more informative for the sentiment classification decision. This mechanism serves a dual purpose: it improves classification performance by focusing model capacity on sentiment-relevant tokens, and it provides an intrinsic source of interpretability by making the importance weights directly inspectable (Vignesh et al., 2025).

D. Output Layer and Classification

The attended representation is passed through a fully connected (dense) layer followed by a sigmoid activation function for binary classification (positive vs. negative), consistent with the evaluation framework established by Almutairi [1]. This design produces a continuous probability score enabling flexible threshold-based classification. For multi-class scenarios (positive, neutral, negative), a SoftMax output layer is employed instead. The complete model architecture is illustrated in Figure 3.

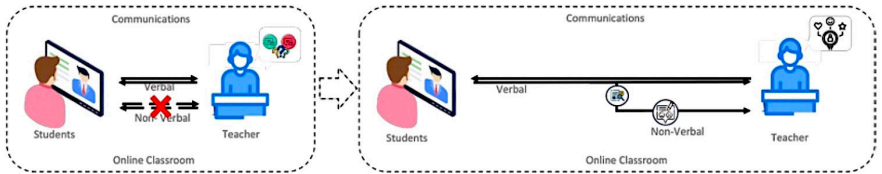


FIG. 3 – Architecture of the proposed BiLSTM-based sentiment analysis model with attention mechanism and XAI integration.

6. Explainability mechanisms

A. Intrinsic Explainability via Attention Weights

The attention mechanism described in Section V provides a natural first layer of intrinsic interpretability. After a forward pass through the network, the attention weight vector $\alpha = [\alpha_1, \alpha_2, \dots, \alpha_T]$ over input tokens $t_1, t_2, \dots, t_T$ directly encodes the relative importance assigned to each token in the final prediction. Visualizing these weights – for example through color-coded token highlighting proportional to weight magnitude – allows educators to intuitively inspect which words most strongly influenced the model’s sentiment judgment for a given piece of feedback.

However, attention weights alone have limitations as explanation tools: they describe the model’s internal information weighting rather than the causal contribution of each token to the output prediction (Salih et al, 2012). Post-hoc explanation methods are therefore additionally employed to provide theoretically grounded feature attribution.

B. SHAP: Global and Local Explanations

SHAP (Lundberg & Lee 2017) is grounded in cooperative game theory and computes the Shapley value for each input feature, representing its average marginal contribution to the model output across all possible feature subsets. For a text classifier, each token in the input sequence is treated as a player in the game, and its SHAP value quantifies how much the prediction changes – on average – when that token is included versus excluded from the input. Positive SHAP values indicate that the token pushes the prediction toward the positive sentiment class; negative values indicate a contribution toward the negative class.

SHAP provides two complementary types of explanations: (1) *local explanations* for individual feedback instances, showing exactly which words drove a specific prediction; and (2) *global explanations* aggregated over the full dataset, revealing which vocabulary terms are the most consistent positive or negative sentiment indicators across all student feedback.

This dual-level analysis is particularly valuable for educators: local explanations support case-by-case review of individual student comments, while global explanations reveal systematic patterns in how students' express satisfaction or dissatisfaction with course content and teaching style (Badawi, 2026; Turkmen, 2025).

C. LIME: Instance-Level Explanations

LIME (Ribeiro, 2016) generates instance-level explanations by approximating the complex BiLSTM classifier with a locally faithful, interpretable surrogate model in the neighborhood of a specific input. For a given feedback sentence, LIME creates a set of perturbed variants by randomly masking tokens, queries the original model for predictions on these variants, and fits a simple linear model to the observed prediction changes. The coefficients of this linear surrogate directly indicate each token's directional contribution to the prediction in the local input neighborhood.

In the context of student sentiment analysis, LIME is particularly effective for explaining predictions on ambiguous or mixed-sentiment feedback – precisely the category of inputs where both the RNN model of Almutairi [1] and the logistic regression baseline exhibited prediction difficulties (e.g., sentences containing both positive content words and negative modifiers). By surfacing the specific tokens that tipped the prediction in either direction, LIME explanations allow educators to critically evaluate model decisions and identify cases where the model may be focusing on superficial lexical patterns rather than true sentiment.

D. Combining SHAP and LIME

The proposed framework combines SHAP and LIME in a complementary manner: SHAP provides theoretically consistent global and local feature importance, while LIME delivers fast, intuitive instance-level explanations optimized for human readability [7]. Together, they offer educators both a macro-level understanding of model behavior and micro-level justifica-

tions for individual predictions. Figure 4 illustrates an example of the combined explainability output, where sentiment-relevant words in a student feedback sentence are highlighted according to their SHAP and LIME attribution scores.

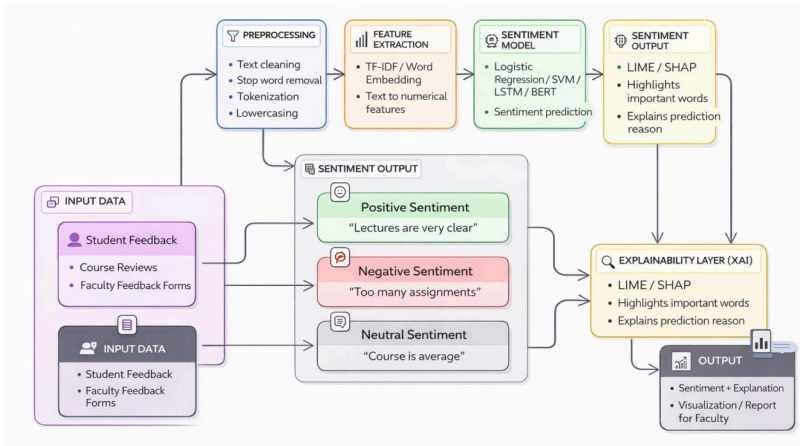


FIG. 4 – Example explainable sentiment output: sentiment-relevant words highlighted by SHAP and LIME attribution scores.

7. Discussion

A. Bridging the Interpretability Gap in Educational AI

The proposed ESA framework directly addresses a critical and widely acknowledged gap in the application of AI to educational feedback analysis: the trade-off between predictive performance and interpretability. As established by Almutairi [1], deep learning models substantially outperform classical machine learning baselines in capturing the sequential and contextual nuances of student sentiment. However, this performance advantage has historically come at the cost of transparency, making such models difficult for non-technical educational stakeholders to trust, validate, or act upon. By augmenting a high-performance BiLSTM model with SHAP and LIME explainability modules, the proposed system preserves the predictive advantages of deep learning while delivering

human-understandable justifications for every prediction. This aligns directly with the findings of (Turkmen, 2025), whose systematic review confirmed that XAI-enhanced educational AI tools significantly increase adoption rates among teachers by making model reasoning accessible and verifiable. Similarly, Badawi [5] demonstrated that integrating SHAP and LIME with a CNN-based educational classifier not only maintained strong predictive metrics but also enabled educators to identify and correct systematic classification biases – an outcome with direct implications for fairness in LMS-based assessment.

B. Handling Nuanced Sentiment in Student Feedback

A key challenge revealed by prior work is the difficulty of correctly classifying mixed-sentiment feedback – sentences that contain both positive and negative elements, or where sentiment polarity is modulated by negation, intensifiers, or discourse structure. Almutairi demonstrated that both RNN and logistic regression models struggle specifically with sentences where negative modifiers like “not” fail to propagate their negation to subsequent sentiment-bearing words, leading to systematic misclassification.

The explainability mechanisms proposed here directly support targeted improvement of these failure modes. When LIME explanations reveal that a model is ignoring a negation token and assigning high positive weight to a subsequent sentiment word (e.g., classifying “the lecture was not engaging and informative” as positive due to the presence of “engaging” and “informative”), educators and model developers can readily identify this failure pattern. Such insights enable targeted data augmentation – adding adversarial examples containing negation structures – or architectural modifications such as incorporating negation-aware attention gates. The qualitative analysis of sentence variations presented by Almutair, 2025 (Table 3) serves as a direct motivating case study for the operational value of instance-level explanations in diagnosing and improving model behavior.

C. Ethical Considerations and Responsible Deployment

The deployment of sentiment analysis systems within LMS environments raises important ethical considerations that explainability can help mitigate. Without transparency, automated sentiment scoring risks encoding biases present in training data – for example, systematic underrepresentation of feedback from non-native English speakers or discipline specific linguistic norms – and propagating these biases into instructional decisions [6]. SHAP global explanations provide an auditable record of which vocabulary features most influence model predictions, enabling systematic bias audits. LIME local explanations allow individual students or instructors to inspect and challenge specific predictions, supporting the principles of algorithmic accountability and the right to explanation increasingly emphasized in educational AI governance frameworks [3].

8. Conclusion and future work

This paper presented an Explainable Sentiment Analysis framework for student feedback systems that integrates a BiLSTM-based deep learning model with SHAP and LIME post-hoc explainability techniques. Building directly upon the sentiment analysis foundation established by Almutairi [1] for LMS environments, the proposed system extends deep learning-based classification with transparent, human understandable explanations that highlight the words and phrases most influential in each sentiment prediction. The framework improves educator trust in AI-generated insights, supports ethical and accountable deployment of sentiment analysis in academic settings, and provides actionable diagnostic information for systematic model improvement.

The proposed architecture – combining contextual word embeddings, bidirectional LSTM processing, attention mechanisms, and dual-method XAI – addresses the core limitations of both traditional machine learning approaches (inadequate handling of sequential context)

and prior deep learning systems (opacity and limited interpretability). The integration of SHAP's theoretically grounded global and local attributions with LIME's intuitive instance-level explanations provides educators with complementary perspectives on model behavior at both the population and individual feedback levels.

Future work will explore several promising extensions. First, the replacement of GloVe embeddings with transformer-based contextual representations (e.g., BERT or RoBERTa fine-tuned on educational corpora) is expected to substantially improve classification performance on nuanced and mixed-sentiment feedback, as suggested by Almutairi, 2025. Second, real-time integration of the ESA system with live LMS platforms such as Moodle and Canvas will be investigated to validate system performance in operational educational environments. Third, large-scale empirical evaluation involving diverse student populations, institutional contexts, and multilingual feedback will be conducted to assess generalizability. Finally, the development of explainability-informed active learning pipelines – where model confidence and SHAP uncertainty estimates guide targeted data annotation – represents a promising direction for continuous model improvement with minimal annotation overhead.

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SEEING THROUGH WORDS. POETRY AS A TOOL FOR VISUAL EDUCATION IN LITERARY STUDIES

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1. Introduction

Early Italian poetry, particularly that of the 13th and 14th centuries, provides a prime setting for exploring the imaginative and figurative dimension of language as an educational tool. The poetic works of Dante, Guinizzelli, Cavalcanti and Petrarch not only evoke a symbolic universe based on visual and sensory images, but also foster cognitive processes of representation and conceptual transposition that engage the reader's aesthetic, emotional and moral spheres (Ciccuto, 2017). The visual education approach allows these texts to be reinterpreted from a pedagogical perspective, emphasising the capacity of poetic language to generate inner visions and to support processes of personal and collective meaning-making (Cometa, 2012).

In a school increasingly characterised by media and imagery, the appreciation of the word as an image provides an opportunity to develop visual and symbolic reading skills, stimulating interpretative creativity and reflection on values (Marrucci, 2023; Pireddu, 2024).

2. The study

This study forms part of a broader research-action and educational experimentation project aimed at testing innovative teaching approaches within the field of literary education; it stems from the need to re-establish the link between word and image in an educational context that is deeply influenced by visual culture but often lacks the interpretative tools required

for symbolic decoding (Moliterni, 2023). From this perspective, the study explores the educational potential of medieval poetry through the lens of visual education, to understand how poetic texts can serve as educational tools capable of stimulating processes of mental imagery, symbolic understanding and the internalisation of values (Sacchini, 2023; Cardilli, 2016).

Poetry is proposed as a space for inner vision, a place where language, emotion and knowledge intertwine, enabling the reader to develop forms of figurative and reflective thought. The educational intervention aims to enhance the poetic word as a tool for visual literacy, capable of educating the gaze, stimulating personal awareness and promoting the construction of meaning through aesthetic experience (Dallari, 2018).

3. Objective of the study

The main objective is to investigate how students construct visual representations based on poetic language, and to what extent these images function as cognitive and affective mechanisms for constructing meaning (Macauda & Russo, 2024; Brogi & D'Angelo, 2024).

The research also aims to highlight the role of visual literacy as a cross-curricular skill that enables the aesthetic dimension of reading to be linked to ethical reflection and the development of sensitivity. From this perspective, early poetry is considered not merely as a subject of literary study, but as an educational space in which language, through its iconic power, becomes an opportunity for knowledge and personal growth.

4. Methodology and instruments

The research adopts an exploratory methodological approach and is based on the integration of qualitative and quantitative tools within a mixed-methods framework. The sample consists of upper secondary school students (N= 74) who are already accustomed to guided reading and metacognitive reflection on poetic texts. They were given a structured

questionnaire designed to collect data on visual perception, the symbolic and value-based understanding of poetic images, and awareness of the process of constructing mental images. The quantitative data were analysed descriptively, whilst the open-ended responses underwent thematic analysis with the aim of identifying the main symbolic categories that emerged – such as light, nature, the body, the journey and transcendence – and of exploring their educational significance. The methodological approach adopted favours an interpretative perspective that recognises the centrality of the reader's subjectivity in the elaboration of poetic meanings generated by the interaction between words and images.

5. Results and discussion

Initial findings suggest that most of the students involved tend to imagine and visualise the content of poetic texts, attributing a fundamental role to mental imagery in the processes of comprehension and identification. The most frequent images are linked to natural and luminous elements and often take on a symbolic or moral significance. The act of 'seeing with words' takes the form of an integrated cognitive experience, capable of activating cognitive, emotional and value-based dimensions. This demonstrates that poetry, when mediated through visual education practices, can foster the development of complex interpretative skills, aesthetic sensitivity and an awareness of the values expressed in the text among students (Zingale & Bellantuono, 2025). The data therefore suggest the need to rethink literary teaching as an educational process that values linguistic visibility and its educational potential.

6. Conclusion

This research confirms the value of the aesthetic-visual approach as a formative and innovative perspective for contemporary literary education. The poetic word, interpreted through the lens of visual education, proves capable of connecting emotion, thought and knowledge, fostering authen-

tic and participatory learning processes (Capaldi & Gola, 2022). Reading poetry thus amounts to learning a way of seeing, of inhabiting images and of recognising in them a universal language of values and meanings. From this perspective, medieval poetry does not belong solely to the literary heritage, but becomes a space for personal and collective growth, a tool for aesthetic reflection and for the formation of the interpreting self.

Keywords

literary education; visual education; humanities teaching; aesthetic education; metacognitive reflection.

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COUNTER-NARRATIVE LEARNING ECOLOGIES. ETHNO-CRIMINAL PEDAGOGY, DIGITAL STORYMAPPING AND INCLUSIVE MEDIA LITERACY IN HIGH-RISK CONTEXTS

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1. Introduction

In contemporary societies marked by migration, territorial inequality and digital hyperconnectivity, organised crime should not be interpreted only as a legal or economic phenomenon. It also operates as a parallel system of socialisation that transmits values, behavioural norms, scripts of belonging and models of success to young people exposed to marginalisation. While the literature has widely examined deviance, inclusion and media education, these domains have rarely been connected in order to explain how criminal organisations compete with schools and civic institutions in shaping identity, aspiration and participation (Cavadi, 2005; Couldry & Hepp, 2018). In this sense, ethno-criminal pedagogy provides an original framework for analysing the educational force of criminal cultures, understood as systems capable of teaching loyalty, hierarchy, recognition and symbolic power through everyday practices, ritualisation and shared narratives. The spread of social media and AI-mediated communication makes this issue even more urgent. Digital environments increasingly influence how young people perceive visibility, authority and opportunity, especially where legitimate pathways of social mobility appear weak or inaccessible (Hobbs, 2017; UNESCO, 2025). For this reason, crime prevention should also be reframed as a matter of inclusion, critical media literacy and learning innovation.

2. The study

This study is part of a broader interdisciplinary project on educational systems and deviance and investigates how organised crime functions as an informal pedagogical ecology in intercultural and high-risk territories. Starting from a comparison between Italian clan structures and the Nigerian Black Axe network, the research explores how criminal affiliation is learned, legitimised and reproduced through language, hierarchy, initiation and future-oriented narratives. At the same time, it reinterprets these findings from the perspective of inclusive education and digital communication in order to identify possible counter-pedagogical strategies. The theoretical assumption is that, where educational institutions fail to produce recognition, participation and meaningful skill development, criminal networks may fill this void by offering identity, status and perceived empowerment. The study therefore proposes a shift from reactive anti-deviance discourse to proactive educational design, integrating digital story-mapping, critical media literacy and AI-aware narrative reflection as tools for inclusion and democratic engagement (Buckingham, 2013; Medrado & Rega, 2023).

3. Objective of the study

The main objective is to analyse how ethno-criminal pedagogy helps explain the transmission of deviant models across local and transnational contexts, and to what extent this framework may support the design of innovative educational interventions for young people at risk of exclusion. More specifically, the study identifies the symbolic, relational and communicative devices through which organised crime constructs belonging, loyalty and legitimacy, and investigates how these same dimensions can be reworked through inclusive and digitally mediated pedagogical practices. The research also highlights digital skills and media literacy as strategic competences for prevention. From this perspective, inclusion concerns not only access to education, but also the capacity to interpret communication

environments critically, decode dominant narratives and generate alternative imaginaries of agency and citizenship (Livingstone & Sefton-Green, 2016; Sen, 1999).

4. Methodology and instruments

The research adopts a qualitative comparative design within an interdisciplinary framework combining pedagogy, anthropology, criminology and media education. Fieldwork lasted thirteen months, from April 2023 to May 2024, and was conducted in Bari and in Borgo Mezzanone, in the province of Foggia. The study employed discreet observation, desk-based inquiry and in-depth interviews with eight adult male participants, four linked to Italian clan environments and four to the Nigerian Black Axe system, selected through purposive sampling for theoretical saturation in order to reconstruct biographies of affiliation, forms of internal learning and representations of power, identity and mobility (Flick, 2018; Palmisano, 2019). The analytical approach focused on power relations, informal educational content, ritual practices and narrative structures. To ensure the safety of the participants and the researcher, strict ethical protocols for anonymity and secure data handling were adopted, while acknowledging the researcher's positionality as an external observer navigating high-risk environments. To strengthen the applied value of the project, the empirical findings were also read in dialogue with research on media education and inclusive technologies, making it possible to outline a transferable model of prevention based on digital storymapping, social media literacy and reflective use of emerging technologies (Patton & Economy, 2014; Toto, 2019; Toto, 2020).

5. Results and discussion

Initial findings suggest that criminal belonging is sustained by powerful pedagogical mechanisms. Interviewees describe criminal organisations as spaces of apprenticeship in which one learns obedience, symbolic

codes, territoriality, emotional control and strategic communication. For example, the strategic use of communication by clans to project an image of invincibility and success emerged as a recurring narrative. Affiliation is perceived not only as a response to economic scarcity, but also as a route to visibility, masculine recognition and future possibility. In this sense, criminal systems operate as educational agencies that generate meaning and aspiration where formal education is experienced as distant or ineffective. The comparative analysis also shows that, although culturally different, the two contexts are structurally analogous in their use of ritualisation, hierarchy, narrative legitimisation and collective memory. This indicates that prevention cannot rely on legal deterrence alone. It requires learning environments capable of offering counter-narratives, participation and credible opportunities for empowerment. The evidence that emerged from the interviews regarding the strategic use of communication by clans directly informed the choice of digital storymapping as a countermeasure, allowing youth to deconstruct these dominant narratives and map alternative, positive trajectories in their territories. The findings therefore support the hypothesis that digital storymapping and critical media literacy may function as inclusive counter-pedagogies, enabling marginalised youth to narrate place, decode power and transform social media from a space of mimicry into a space of civic agency and sustainability.

6. Conclusion

This research confirms the heuristic value of ethno-criminal pedagogy as an innovative framework for understanding organised crime as a competing learning ecology rather than as a merely repressive issue. By connecting deviance studies with inclusion, digital skills, social media and learning innovation, the paper advances a theoretically grounded and empirically informed perspective that is highly relevant to contemporary educational challenges. The findings suggest that effective prevention depends on

the capacity of schools, universities and third-sector organisations to design credible environments of belonging, participation and empowerment. From this perspective, the educational response to deviance should not only interrupt harmful trajectories but also generate alternative futures through evidence-based, inclusive and technologically informed practices. Ethno-criminal pedagogy thus emerges not only as an interpretative category, but also as a strategic horizon for policy, teacher education and community intervention in contexts marked by vulnerability and social fragmentation.

Keywords

inclusion; digital skills; social media; sustainability; empowerment.

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DIGITAL DYNAMICS AND THE PERFORMATIVE TURN: REDEFINING EXPERTISE AND TEXTUAL FORMS IN THE ITALIAN SCIENCE OUTREACH ECOSYSTEM

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Abstract

In the contemporary sociocultural landscape, the traditional boundaries between academic research and public discourse are undergoing a structural reconfiguration. This paper explores the emergence of the “scientist-performer” as a central actor in the Third Mission of universities. By adopting an exploratory, mixed-methods design, the research investigates how digital dynamics and audio-visual literacy redefine scientific “texts” in professional and educational contexts. Preliminary results from a national mapping of science outreach in Italy suggest a significant mobilization of experts who integrate artistic languages to lower participation barriers. However, a persistent “science bubble” remains, highlighting a mismatch between transactional metrics and qualitative social impact. This work proposes a shift in evaluative paradigms toward a nuanced understanding of communication as a performative act of scientific citizenship.

Keywords

Social Engagement, Scientific Communication, Third Mission.

1. The Evolving Nature of Communication

Scientific communication has been described as the “essence of science”, representing a fundamental precondition for the integration of research into the collective knowledge corpus (Garvey, 1979). Traditionally, this process was divided into formal dissemination and informal social interac-

tions, but the rise of the digital public sphere has blurred these distinctions. This shift has created a hybrid environment where scientific legitimacy is increasingly negotiated through visibility and cultural resonance (Bauer & Jensen, 2011). In this context, the role of the expert is no longer confined to the unidirectional dissemination of data (the so-called "deficit model") but is instead defined by active participation in the broader cultural industry (Bencivelli & De Ceglia, 2013). The transition toward a "Post-Normal Science" has further fostered a methodology where uncertainty is managed and values are made explicit through interactive dialogue rather than formalized deduction (Funtowicz & Ravetz, 1993). This evolution is particularly evident in the diversification of scientific "storytelling", where researchers are increasingly acting as curators of content, utilizing aesthetic and emotional engagement to bridge the gap between specialized knowledge and society.

2. Performative Languages and Textual Redefinition

Contemporary outreach initiatives often utilize hybrid languages (theater, visual arts, and digital media) to transform traditional scientific texts into immersive story worlds. This "Guerilla Science" approach embeds professional knowledge into unexpected cultural contexts to reach non-expert audiences who might otherwise avoid formal scientific venues. By focusing on audio-visual literacy, these initiatives redefine textual forms, moving from static papers to dynamic, lived experiences (Stoferet al., 2019). The digital public sphere offers both a promise of democratization and a challenge to scientific authority. While it enables active conversations between experts and citizens, it also necessitates a new form of "reflexive expertise" capable of navigating machine-readable contexts and algorithmic influences (Airoldi, 2021). This mastership of digital literacy is becoming a prerequisite for the modern professional, who must ensure that communication remains meaningful within structured human relationships and educational methodologies.

3. Evidence from the Italian Landscape

The investigation focuses on a national mapping of independent outreach initiatives in Italy to observe how academic figures engage in broader social fabrics. The empirical baseline was established through a national exploratory survey administered to organizers of 103 unique independent outreach events between November 2025 and February 2026. Selection criteria prioritized initiatives promoted by autonomous actors (such as foundations and cultural associations) across the Italian territory, deliberately excluding university-led events to investigate how scientific authority is negotiated within the broader, non-institutionalized social fabric. The preliminary analysis reveals a substantial commitment from the professional community, with a visible shift from the expert as a simple “speaker” to a “curator” of content. Data indicates that over 62.2% of involved researchers assume high levels of creative and pedagogical responsibility in the design of these encounters. A key finding of this study is the high degree of language hybridization: over 91.3% of analyzed initiatives integrate artistic and cultural activities, such as music or performance, confirming that textual redefinition is becoming a standard for social inclusion. Despite this mobilization, a “valuation mismatch” persists within the ecosystem. This ‘valuation mismatch’ was operationalized by comparing the qualitative methodologies employed by organizers to assess success (centered on public resonance, wonder, and emotional discovery) against the transactional metrics predominantly demanded by funding stakeholders, such as administrative financial reports and quantitative headcounts. While public resonance is driven by wonder and discovery, institutional stakeholders often continue to prioritize transactional metrics, such as participant counts or financial reports, over the qualitative impact on scientific culture and public trust. This highlights a gap between the performative agency of the scientist and the bureaucratic frameworks of institutional evaluation.

4. Implications and Future Directions

The reconfiguration of the expert-public interface transforms communication into a vital tool for civic empowerment. The “performative scientist” represents a necessary evolution in an era of digital dynamics and contested expertise, where the ability to bridge technical jargon and lived experience is paramount. To bridge existing gaps, institutional policies must move beyond quantitative counting toward evaluative paradigms that prioritize thematic comprehension and targeted communication (Rosin et al., 2021) This study highlights that the acquisition of performative skills and audio-visual literacy is no longer an optional asset but a fundamental professional requirement for the contemporary academic. This shift is driven by the need for universities to comply with evolving institutional mandates (e.g., ANVUR) regarding public engagement and the Third Mission, which demand a more sophisticated communication of research results. Consequently, there is an urgent need for ‘hybrid’ academic figures who possess the dual capacity to maintain scientific rigor while mastering digital strategies and performative techniques to bridge the gap between technical expertise and the public’s lived experience.

Future inquiries will delve deeper into the long-term impact of these performative encounters on scientific citizenship, examining how digital platforms can either burst or reinforce existing “science bubbles.” Ultimately, this study seeks to provide a robust framework for evaluating the social impact of communication beyond mere presence, fostering a truly inclusive dialogue within professional and educational settings. While providing a robust national baseline, this study acknowledges limitations inherent to its exploratory nature and geographic contextualization within Italy, as well as the potential for self-reporting bias among organizers and the constraints of a cross-sectional snapshot design.

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STUDENTS' PERCEPTIONS OF ACTIVE LEARNING IN MULTICULTURAL BUSINESS EDUCATION: A TRIANGULATED STUDY AT HESTIM BUSINESS SCHOOL, MOROCCO

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Abstract

Active pedagogical approaches such as Learning by Doing have gained increasing attention in business education, yet empirical evidence remains limited in multicultural African higher education contexts. This study examines first-year students' perceptions of an active learning experience and triangulates these self-reports with teacher-assessed performance metrics. The pedagogical activity, conducted within the "Cycle débat – Séminaires de Culture Générale" course at HESTIM Business School (Casablanca, Morocco), engaged 43 students from 13 African nationalities, organized in seven groups, in country-representation booths, oral cultural presentations, and structured intercultural debates. Adopting a post-experience survey design, data were collected through a structured questionnaire (18 Likert items, 5-point scale) administered after the activity, with items adapted from validated scales: Handelsman et al. (2005) for engagement, Loughry et al. (2007) for teamwork, Dearsdorff (2006) for intercultural competence, and Caspi & Blau (2008) for perceived learning. The questionnaire was completed by 31 students (response rate: 72.1%).

Internal consistency was high (overall Cronbach's $\alpha = 0.914$). Results indicate that students report substantial perceived gains, particu-

larly in teamwork ($M = 4.67/5$, $SD = 0.43$), intercultural competence ($M = 4.48$, $SD = 0.54$), and engagement ($M = 4.53$, $SD = 0.49$). Overall satisfaction was very high ($M = 4.75$, $SD = 0.37$), with 100% of respondents recommending the approach. These self-reports are corroborated by teacher-assessed performance metrics: mean project grade = 17.05/20 and mean participation grade = 15.92/20. Key limitations include the absence of a pre-test design, social desirability bias, and a single-cohort convenience sample. The study contributes empirical evidence on perceived outcomes of active intercultural pedagogy in an under-represented African business school context.

Keywords

Active Learning, Experiential Learning, Students' Perceptions, Soft Skills, Intercultural Competence, Higher Education, Triangulation, Multicultural Business Education.

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EDUCATING TO AI THROUGH FUZZY LOGIC: A COLLABORATIVE LABORATORY ON MODELLING UNCERTAINTY

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1. Introduction

Introducing Artificial Intelligence in secondary education is often associated with coding or examples of machine learning. However, this approach risks overlooking a key issue: how intelligent systems make decisions under uncertainty. To develop a meaningful understanding of AI, students need to engage not only with tools, but also with the models that shape algorithmic reasoning. In this contribution, fuzzy logic is used as a bridge between intuitive reasoning and algorithmic thinking. The laboratory experience described here, conceived as a small-scale design-based intervention, involved 45 students (13th grade) of a Mathematical High School project in Italy (Rogora & Tortoriello, 2021). Structured in two 2.5-hour sessions, it explored fuzzy logic through collaborative modelling, discussion, and reflective tasks. Fuzzy logic (Zadeh, 1965) extends classical logic by introducing degrees of membership, allowing gradual rather than rigid classifications. As a framework for approximate reasoning (Gerla, 2001), it offers a way to represent situations where boundaries are not clearly defined. From a didactic perspective, this makes it suitable for exploring how decisions are structured. At the beginning of the laboratory, students discussed concepts such as “high risk” or “efficiency.” Their answers differed, and what initially appeared as disagreement became a key insight: categories depend on interpretation. Fuzzy logic thus emerged as a language for expressing

this variability. This shift can be interpreted within a constructivist and socio-cultural perspective. As Bruner (1966) notes, understanding develops through active organization of experience; Papert (1980) highlights the role of constructing models; and Radford (2016) emphasizes the social nature of learning. In line with this, students worked in groups to design simple fuzzy systems. Through argumentation and revision, teams progressively negotiated shared criteria, for instance redefining terms such as "low demand" or adjusting the relative weight of "cost" and "environmental impact". From the perspective of AI education, this process is particularly relevant. Intelligent systems operate under uncertainty (Russell & Norvig, 2021), and by building simplified models, students develop an initial understanding of how inputs, rules, and outputs interact. The focus is on developing awareness of how modelling choices influence results.

During the project phase, students worked in small teams on realistic scenarios, defining variables and rules through discussion and negotiation. These exchanges played a central role, leading to the construction of shared models. One aspect that emerged clearly during the activity was the difficulty students initially experienced in making their reasoning explicit. While they were often able to intuitively assess a situation, translating this intuition into structured rules required a shift in perspective. This passage from implicit judgment to explicit modelling was not immediate, but it proved to be one of the most significant learning moments of the laboratory. Such dynamics align with socio-constructivist perspectives (Vygotsky, 1978; Radford, 2018) and cooperative learning research (Johnson & Johnson, 2009). Students took on different roles, and this diversity strengthened the models instead of fragmenting them. An important outcome concerns the perception of uncertainty. Instead of eliminating ambiguity, students explored it, observing how small changes in parameters affect results. This often led to reflections on the non-neutral nature of algorithms, in line with broader discussions on

technology (Floridi, 2014). This insight broadens the discussion of AI beyond its technical dimension. When students realize that models reflect choices and assumptions, they begin to see algorithms as interpretable rather than purely objective. The activity thus supports both computational understanding and a more critical perspective on AI.

Final reflections and group presentations showed increasing awareness that outputs depended on prior modelling choices rather than on neutral computation alone. AI was no longer perceived as a black box, but as something constructed and open to discussion. Evidence was drawn from teacher observation notes, student-produced models, and short written reflections collected at the end of the activity. Although limited to a specific school context and a relatively small sample, the experience suggests that fuzzy logic can offer a transferable framework for introductory AI education and support an education to complexity.

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ACADEMIC SUSTAINABILITY AND CREATIVE INCLUSION: OPEN SOURCE AND VISUAL SCRIPTING IN INTERACTIVE ANIMATION

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1. Introduction

Digital democratization reshapes research on interactive animation (IA) (Zhao et al., 2025) yet costly proprietary software and programming barriers constrain humanities scholars' inquiry. This study explores how open-source software (OSS) and AI assistance foster instrumental sustainability. By integrating Grounded Theory with media evolution via SQL in QualCoder, while employing Visual Scripting for behavioral assessments in an interactive survey, this mixed approach bridges qualitative-quantitative analysis.

2. Mixed Methods Research Design

2.1 Qualitative Analysis and Secondary Development via SQL

To eliminate financial barriers and enhance methodological reproducibility, the open source QualCoder (Zhao et al., 2025) served as the primary qualitative analysis tool for the Grounded Theory (GT) coding of semi-structured interviews conducted with 15 international experts (digital media artists, creative technologists, and academic scholars). To transcend purely qualitative boundaries, custom SQL (Structured Query Language) scripts

lever aged OSS extensibility to query the database. Integrating Python tools, this methodology maps interview codes across chronological media strata (i.e., the historical sedimentation of media–technology co-evolution) (Parikka, 2015) into an intuitive, multi-dimensional visualization. (Code: <https://github.com/BalancerStudioGithub/Qualcoder.git>)

2.2 Quantitative A/B Choice by Visual Scripting

Unlike qualitative queries, the quantitative phase addressed programming hurdles for non-technical designers. Visual scripting (e.g., Unity’s Playmaker and Blender nodes) and AI code generation provided inclusive pathways. Using these, a Preference and Dwell-Time Measurement (PDTM) A/B choice (Zhao et al, 2025) assessed user behavior ($N = 307$). Comparing dwell times in dynamic versus static conditions empirically revealed a preference for interactive fluidity (67.1% of users favored dynamic scenarios with interference), thereby translating human logic into digital testing without manual coding.

3. Discussion and Conclusion

3.1 Democratization of Digital Instruments

The integration of these mixed methods highlights the broader democratization of digital tools. Open-source technologies, visual scripting, and AI-assisted workflows not only lower technical entry barriers but also reduce dependence on centralized corporate control inherent in proprietary software (Stoliarchuk, 2024). Customizing these tools addresses specific analytical needs: mapping codes with QualCoder via SQL chronologizes media strata to construct the ‘Media-Tech Soil’ (Zhao et al., 2025) (a conceptual framework in communication studies for bridging scientific-humanistic cultures), while PDTM visualization indicates a tendency toward dynamic and uncertain interactions over static scenarios, thereby empirically validating the role of accessible tools in driving democratized digital research.

3.2 Instrumental Inclusion for Academic Sustainability

Open-source tools and code visualization drive digital democratization, breaking economic and technical barriers for IA research. By transforming a qualitative platform into a comprehensive time-visualizer via SQL queries, and utilizing visual scripting for quantitative PDTM, this study establishes an innovative and accessible methodological approach. It supports broader academic participation, especially for fine arts scholars, and fuels the interdisciplinary integration of technology and culture in the digital age.

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RETHINKING THE PYTHAGOREAN THEOREM: A VERTICAL AND INTERDISCIPLINARY TEACHING EXPERIMENT

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Abstract

In today's educational landscape, characterized by increasing fragmentation of knowledge, there is a need to rethink the teaching of mathematics in an integrated and inclusive way. This paper proposes and analyses a vertically integrated teaching experiment across lower and upper secondary education, centered on the Pythagorean theorem, conceived not merely as a formula to be applied, but as a conceptual hub capable of connecting different languages, disciplines and ways of thinking (Agarwal, 2024). The proposal is designed as an interdisciplinary STEAM workshop integrating mathematics, music and technology, in which students engage in digital exploration and manipulation fostering relational, creative and transdisciplinary thinking. During the operational phases of the laboratory students construct right-angled triangles and squares on their sides, within a dynamic digital environment (Polypad) and then experiment with processes of decomposition and recomposition of areas, observing the invariance of the Pythagorean relationship as geometric configurations vary. In this context, the connection with music is not merely illustrative, but introduces a structural analogy between geometric relationships and sound frequency ratios, fostering a relational understanding of concepts and expanding the contexts of meaning in mathematical learn-

ing (Azaryahu et al., 2023; De Castris et al., 2025). Students are invited to explore proportional relationships through simple musical intervals and frequency ratios, relating auditory patterns to geometric invariants observed during the activities. This integration also supports affective dimensions of learning, such as self-efficacy and active student engagement (Bicer et al., 2020). The activity is part of the Mathematical High School Project (MHS), an initiative developed in collaboration between Italian universities and secondary schools, with the aim of promoting a broad, cultural and interdisciplinary view of mathematics (Tortoriello & Nigrelli, 2025). The use of Polypad enables the creation of a dynamic and accessible learning environment in which students can explore, manipulate and visualize geometric relationships, fostering shared meaning-making processes (Genç, 2024). The pilot study, starting in May 2026, will initially involve approximately 50 lower secondary school students, with the planned extension to upper secondary school classes within the vertical framework of the project, and will examine how digital tools and inquiry-based approaches affect students' conceptual understanding, argumentative practices, and attitudes towards mathematics. Particular attention will be paid to students' verbal justifications and their ability to connect different forms of representation. The methodology adopted is qualitative-exploratory and is based on classroom observations, the analysis of peer interactions, students' verbal explanations, and the collection of physical and digital artefacts produced through manipulative and dynamic learning activities. Attention will be paid to the communicative dimension and the use of different semiotic registers (Duval, 2017). From a theoretical perspective, the study is grounded in the integration of constructivist and socio-cultural perspectives on learning, emphasizing the role of teaching mediators and the plurality of representational registers (Bartolini B. & Mariotti, 2008), which allow mathematical learning to be interpreted as a situated process, mediated by tools, languages and inter actions. A distinctive feature of the proposal is the idea of "prov-

ing without formulas", implemented through activities based on visual and manipulative representations. As highlighted by Arcavi (2003), such representations are a key cognitive resource for understanding mathematical structures, facilitating the transition from intuition to formalization. Through the dynamic decomposition and recomposition of areas associated with the sides of a right-angled triangle, students are guided to recognize invariants and relationships, transforming empirical observations into geometric necessity, in line with a view of proof as a process of explanation and exploration (Hanna, 2000). In conclusion, this paper presents a preliminary model of educational innovation that, through the informed use of digital technologies and an interdisciplinary approach, aims to foster learning environments in which mathematics, communication and culture intertwine for research and educational practice.

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BEYOND THE ORACLE EFFECT: A PROMPTING PROTOCOL BASED ON DE BONO’S SIX THINKING HATS FOR DEVELOPING DEDUCTIVE THINKING IN THE FIRST TWO YEARS OF HIGH SCHOOL

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Abstract

The integration of Generative Artificial Intelligence into the educational landscape is no longer a future possibility but a reality that is transforming the teaching of mathematics. However, as highlighted in the literature (Luckin, 2018; Holmes et al., 2019), the risk of uncritical use of digital tools can lead to “cognitive laziness” that undermines the foundations of logical-deductive thinking. In the first two years of high school, this challenge is particularly acute: students are navigating the delicate transition from procedural thinking, typical of algebraic calculation, to the hypothetical-deductive thinking required by Euclidean geometry. In this scenario, AI can emerge as a “Boundary Object” capable of mediating between the student’s intuitive understanding and the formal rigor of the discipline, provided that its introduction is supported by a solid methodological framework. Building on the research presented at ICS Exchange 2025, which highlighted the effectiveness of chatbots in motivating students but also the risk of cognitive dependence on AI “hallucinations”, this work aims to structure human-machine interaction to safe guard the learner’s critical thinking. The in-

roduction of AI dismantles the traditional paradigm of the “infallible source”. By redefining critical thinking (Ennis, 1989; Paul & Elder, 2006) as the rigorous evaluation of arguments, the inherently fallible nature of AI forces students into constant validation, transforming them from passive learners into active “logical reviewers”. While in our previous work we asked whether AI could support problem-solving, here we ask how: what methodological framework can ensure that AI remains a “semiotic mediator” (Matteucci et al., 2024) and not a mere substitute for thought? Drawing inspiration from Radford’s Theory of Objectivation, which interprets learning as a social process of “becoming aware” mediated by tools and dialogues (in this case, the chatbot), we propose adapting Edward De Bono’s “Six Thinking Hats” method to the practice of mathematical prompt engineering. This framework is presented here as a tool for metacognitive regulation, where interaction with the chatbot allows for the objectification of various mental “postures” necessary for solving a proof in the first two years of high school:

- White Hat (Data Analysis): Rigorous identification of hypotheses and theses.
- Red Hat (Intuition and Visualization): Perception of the big picture, its variations, and management of uncertainty.
- Yellow Hat (Logical Optimism): Evaluation of the effectiveness and elegance of one strategy compared to another.
- Green Hat (Creativity): Exploration of auxiliary constructs or alternative methods.
- Black Hat (Critical Judgment): Identification of logical flaws in both one’s own reasoning and the AI’s output.
- Blue Hat (Metacognition): Synthesis and reflection on the entire logical process undertaken.

To transition this theoretical framework into a field-validated study, an experimental phase is scheduled for the first semester of the 2026/2027 ac-

ademic year. The study will involve two classes (9 and 10 grade) of a Scientific High School. The chosen AI model is the free tier of ChatGPT (model GPT-4o), selected for its accessibility and advanced reasoning capabilities. The interaction will be guided by specific system prompts designed to activate the Six Hats, and the effectiveness of the intervention will be evaluated through a mixed-methods approach combining quantitative pre-/post-tests on Van Hiele geometric thinking levels with qualitative chat log analysis focused on students' prompting skills.

While the full-scale data collection is planned for the upcoming academic year, preliminary evidence from a small-scale proof-of-concept phase suggests a significant behavioral shift: when using the "Black Hat" protocol to debug AI-generated proofs, students moved from passive consumers to proactive validators, increasingly cross-checking AI outputs with textbooks and geometric axioms. These findings suggest that the Six Hats protocol may counter cognitive laziness and foster autonomous critical thinking.

The ultimate goal is to demonstrate that AI, when queried using the Six Thinking Hats protocol, ceases to be a "black box" that provides ready-made solutions and instead becomes a dialectical partner. The originality of this proposal lies in transforming the technological limitations of LLMs (such as the tendency to make logical errors) into educational opportunities, supporting students' independence and critical thinking and mastery of the subject matter. In line with the focus on Sustainable Entrepreneurship & Skills Development, this approach aims not only at mathematical rigor but also cultivates the soft skills necessary for ethical and sustainable interaction with emerging technologies.

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ANALYSIS OF A GAME-BASED LEARNING INSTRUMENT FOR THE DEVELOPMENT OF SKILLS RELATED TO FIGURAL CONCEPTS

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Abstract

The Game-Based Learning literature generally agrees that mathematical games enhance students' motivation and inclusion, but such benefits do not always lead to effective learning of the mathematical content embedded in gameplay. Since 2021, our research team has investigated *Geometriko* (*G*), a widely used mathematical game in Italy addressing curricular topics such as the Theory of Quadrilaterals and meta-mathematical notions including definition and theorem (Tortorelli & Matteucci, 2024). Since 2016, the National Geometriko Tournament has involved approximately 25,000 students from grades 4–11 across Italy. Previous doctoral study found that *G* increases motivation and improves disciplinary outcomes compared with traditional instruction (Tortorelli, 2025). However, assessment tasks integrated into gameplay suggest limited effectiveness in fostering figural concepts, a key competence for understanding geometrical definitions. The Theory of Figural Concepts was therefore used to interpret gameplay errors linked to the dual figural and conceptual nature of geometrical objects and to the need for their non-spontaneous coordination through explicit didactic mediation. This theory was fundamental to analysing game-play errors

caused by the dual nature of geometrical concepts (figural and conceptual aspect) and the need for their harmonisation. Figural concepts (Fischbein, 1993) are hybrid cognitive structures in which geometric objects are simultaneously processed as visual-spatial figures and formally defined mathematical entities. In order to enhance the effectiveness of *G*, the Doctoral Study developed an upgraded version called *Geometriko Academy (GA)*. Since 2024, *GA* has replaced *G* in the *National Tournament*, both in preparation activities and in official matches. The upgraded version introduces the *Fischbein’s cards*, specifically designed to address the identified learning difficulties. We hypothesise that the use of these cards requires players to activate an interplay between the figural and conceptual components of quadrilaterals. Additionally, *GA* includes a new rule requiring players to justify defensive statements. To address RQ1, the study compares two samples of 100 fourth- and fifth-grade students (*G*: 7th-8th editions; *GA*: 9th-10th editions) from consecutive National Tournament editions. Group *GA* students came from the same schools and generally the same teachers. Although selection was not randomised, baseline equivalence was established through pre-intervention indicators (previous tournament scores and initial qualification rounds). No statistically significant baseline differences were found, suggesting reasonable comparability despite the quasi-experimental design. Across all four editions, the same referees (mathematics teachers) recorded all gameplay tasks requiring figural concepts and students’ responses during official matches. A quantitative analysis was conducted. In the seventh and eighth editions, students used *G*, whereas in the ninth and tenth editions they used *GA*. The comparison of the percentages of correct responses suggests that *GA* is substantially more effective as a mediating tool for the development of *figural concepts*. To address RQ2, a smaller sample was selected, consisting of one 5th-grade class participating in the ninth edition of the *Tournament* (2024). In this case, a qualitative study was conduct-

ed based on transcripts of recorded student dialogues during matches played with *G* (first phase of the experiment) and with *GA* (second phase). Transcripts and gesture notes were analysed through Fischbein-informed thematic discourse analysis. Episodes involving justification or figural–conceptual conflict were purposively selected. Two independent coders analysed the data, reaching 87% agreement before consensus discussion. The qualitative analysis provides further support for the findings related to RQ1 and highlights how the innovations introduced in *GA* enhance its effectiveness in fostering figural concepts. Three main strengths emerge: (1) as hypothesised, *Fischbein's cards* effectively compel students to engage in an interplay between figural and conceptual components; (2) the requirement to justify defensive statements also promotes coordination between these two aspects; (3) the redefined role of the teacher in *GA* – as a mediator of learning and an orchestrator of mathematical discussions based on incorrect gameplay statements – aligns with a Vygotskian perspective and with the principles of the *Theory of Semiotic Mediation* (Bartolini Bussi & Mariotti, 2008). *GA's* effectiveness appears to derive from a theoretically grounded design that avoids quiz-based models, where disciplinary content remains external to gameplay and promotes superficial learning. In *GA*, players must reason within the conceptual structures of logic and quadrilateral theory, while the teacher orchestrates the activity, transforming the game from a procedural exercise into an instrument for semiotic mediation. The study is limited by the absence of a concurrent control group, the context-specific Italian sample, and potential interpretative bias arising from the authors' role in design and analysis, although RQ1 data were collected by teachers external to the research team during tournament matches. Accordingly, findings should be interpreted cautiously, particularly regarding causal inferences and generalisability.

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ARTIFICIAL INTELLIGENCE FOR TERRITORIAL INNOVATION: AN EMPIRICAL EVALUATION OF THE IDEA MODEL

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Abstract

This paper introduces the IdeA Model (Inventio, Dispositio, Elocutio, Actio), a pedagogical framework for AI-assisted instructional design rooted in classical rhetoric and reinterpreted through generative AI and project-based learning. The model conceptualises large language models as cognitive partners across four structured phases: analogical idea generation, project planning, multimodal communication, and community-oriented implementation, offering a theoretically grounded approach to fostering meta cognitive AI use and inclusive pedagogy in higher education.

The framework was examined through a pilot, one-shot pre-experimental study involving undergraduate students (N = 105; Mage = 23.6, SD = 5.67; 95% female) enrolled in a General Didactics course addressing socio-territorial challenges in an inner area of Southern Italy characterised by youth depopulation and underutilised cultural heritage. Following an introductory lecture and a 75-minute collaborative design activity supported by generative AI tools, students developed territorial valorisation projects. A structured questionnaire assessed four constructs grounded in the Technology Acceptance Model (TAM): perceived usefulness, ease of use, thinking activation was operationalised as students' self-reported capacity to transfer metaphorical and cross-domain reasoning to real territorial problems, measured via a 5-item Likert subscale (e.g., "Using AI helped me find unexpected connections between ideas"). Civic en-

gement was defined as perceived motivation to actively contribute to local territorial challenges, assessed through a 4-item subscale.

Results indicated consistently favourable perceptions, with mean Likert scores (1–5) ranging from 3.62 to 4.05 (SD range: 0.79–1.04). The highest ratings concerned critical AI literacy ($M = 4.05$, $SD = 0.90$), applicability to real-world contexts ($M = 4.02$, $SD = 0.83$), and collaborative support ($M = 4.04$, $SD = 0.88$). Qualitative feedback identified *Inventio* and *Dispositio* as the most cognitively engaging phases. Challenges emerged specifically in prompt design – notably the difficulty of translating open ended territorial problems into effective and sufficiently constrained AI queries – and in idea convergence, understood as the negotiation of divergent group contributions into a coherent project proposal. These difficulties suggest the need for structured scaffolding in future iterations of the model. The gender imbalance in the sample (95% female) reflects course enrolment demographics and is acknowledged as a limitation on generalisability. Future research should additionally examine whether this composition may have influenced collaborative dynamics and attitudes towards AI assisted work, in line with existing literature on gender and technology acceptance. Findings suggest the IdeA Model represents a promising and transferable approach to integrating generative AI within Universal Design for Learning principles, contributing to the emerging discourse on AI-enhanced inclusive pedagogy in teacher education contexts. To consolidate these findings, future studies should employ quasi-experimental designs with control groups, longer intervention periods, and qualitative triangulation through content analysis of student project outputs and post-activity focus groups.

Keywords

generative AI; territorial design; higher education; project-based learning; AI literacy; inner areas; Southern Italy.

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NAPIER'S POP-UP MUSEUM

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1. Background and motivation

This contribution presents the second phase of an educational project developed during the 2025/26 school year in a second-grade primary classroom (17 pupils) at I.C. “G. Genoino” in Frattamaggiore (Naples, Italy). The project builds on a previous experience presented at ICS Exchange 2025, where students used physical and virtual Napier’s bones to approach double-digit multiplication before fully mastering multiplication tables and procedural automatisms (Palladino et al., 2025). The positive outcomes observed during the first intervention, particularly in terms of participation, collaboration and reduction of mathematics-related anxiety, inspired the development of a new activity in which the classroom was transformed into an interactive pop-up museum dedicated to John Napier and the history of calculation devices.

2. Research objectives

The project draws on the socio-cultural perspective of Luis Radford, according to which mathematical learning develops through social interaction and the use of cultural artifacts. In this context, Napier’s bones are not only calculation tools, but mediators that support collaboration, discussion and shared mathematical understanding. The project also adopts a Phygital approach, combining physical manipulation and digital interaction, while EntreComp and DigComp provide the frame-

work for the development of transversal, entrepreneurial and digital competences.

The study explores how a museum-based and collaborative learning environment can support mathematical reasoning, historical awareness and inclusion in primary education. A qualitative action-research approach was adopted through a single exploratory case study involving 17 pupils aged 7–8 years. Although the number of participants is limited, the choice is coherent with the exploratory nature of the study and with the intention to closely observe interaction dynamics and meaning-making processes within an authentic classroom context.

3. Educational and research methodology

The activity is developed through a Phygital methodology that integrates physical artifacts (giant bones and paper kits) with digital tools (simulation software and tutorials via QR Code) (Barone, 2025). The class is organized like a small startup and is divided into different teams: History, Communication, Interaction and Digital; each team has specific and real tasks and responsibilities. Each team has specific and real tasks and responsibilities that collaborate to map the spaces, design the user experience and manage the reception of visitors. This is where User Experience (UX) comes into play: students learn to design not just objects, but ‘senseful experiences’, ensuring that each station is intuitive, inclusive and capable of emotionally engaging the public.

Students were organized into functional teams inspired by startup environments (History, Communication, Interaction and Digital) and collaboratively designed exhibition materials, interactive activities and multimedia supports.

4. Preliminary or expected results

Data collection included classroom observation grids, analysis of students’ artifacts, teacher reflective journals and informal feedback collect-

ed during debriefing sessions. Preliminary observations suggest high levels of engagement and participation, especially among pupils usually less confident in mathematics-related activities. The role-based organization appeared to encourage distributed participation and allowed students with different strengths – logical, communicative, graphic or technological – to contribute meaningfully to the collective task. The use of Napier's bones as historical and manipulable artifacts also seemed to reduce anxiety linked to memorization and procedural performance, promoting exploratory reasoning and peer collaboration. Although limited by the small sample size, the absence of a control group and the qualitative nature of the collected data, the project appears potentially transferable to other educational contexts thanks to its modular structure and alignment with European competence frameworks.

5. Conclusions and implications

The planned teaching activity aims to emphasize guidance-oriented teaching and cooperation, in addition to acquiring STEM and historical skills: through stress test simulations and team role-playing, students learn to manage the unexpected and support each other to ensure the museum runs smoothly (corporate team building applied to schools). In this way the fragility of the individual is transformed into the strength of the group and Napier's bones act as a social aggregator: They eliminate the performance anxiety of mnemonic calculation and allow every child – from the most technologically savvy to the most creative – to find their own space for success.

The activity aims to analyze how knowledge, the study of the origins, the use of Napier's bones can become the catalyst for the development of entrepreneurial (Entre Comp) and digital (DigComp) skills and can be a common element of a collective performance that promotes inclusion and enhances the different talents (graphic, communicative, logical and organizational) in a perspective of active citizenship and

educational innovation (Radford, 1997). As further objectives, we expect the project to be functional in terms of inclusiveness, orientation and to provide an operational model that can be replicated in different school contexts.

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LEVEL UP YOUR ASSESSMENT: THE BOOK-AS-A-GAME MODEL FOR FOSTERING INCLUSIVE EVALUATION SKILLS AND FEEDBACK LITERACY

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The growing emphasis on skills development in higher education requires teaching models capable of supporting assessment literacy, feedback literacy, and self-regulated learning through inclusive and engaging learning environments (Carless & Boud, 2018). While digital serious games and stealth assessment have been widely investigated, less attention has been paid to the structural gamification of traditional learning materials. This study examines the book-as-a-game model (Khaldi et al.2023), namely an academic textbook redesigned as a level-based learning environment structured through progression, challenges, rewards, and authentic tasks, in order to explore its potential for fostering inclusive evaluation competences among pre-service teachers (Subhash et al., 2023). The research aims to investigate whether a structurally gamified textbook can enhance engagement with assessment practices, reduce assessment-related anxiety, and strengthen feedback literacy within teacher education (Xu & Brown, 2016; Yan & Carless, 2022). A mixed-methods design will be adopted involving a cohort of university pre-service teachers. Quantitative data will be collected through pre- and post-intervention questionnaires focused on intrinsic motivation, assessment-related anxiety, and feedback literacy, together with learning analytics documenting students' progression across the book's levels and activities. Qualitative data will be gathered through focus groups and the analysis of authentic assessment tasks embedded in the gamified learning pathway. The expected contribution of the study is

twofold. First, it explores structural gamification as an alternative to fully digital game-based environments, showing how a textbook can be reconceptualized as an interactive and competence-oriented learning architecture. Second, it offers a research-based framework for connecting inclusive assessment, feedback practices, and learner self-regulation in higher education. In this sense, the proposal aligns with ICS Exchange 2026 by addressing the development of key educational skills through innovative and scalable learning design, with particular relevance to the Learning and Technologies, Education, and Inclusion tracks.

Keywords

gamification; feedback literacy; inclusive assessment; self-regulated learning; teacher education.

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BEYOND THE SCREEN: TECHNOLOGIES THAT TRANSFORM THE SCHOOL

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1. Why ICT is not a tool, but a learning environment

Information and Communication Technologies (ICT) represent a structural component of contemporary teaching processes, influencing pedagogical models, curriculum design, and assessment practices. The perspective adopted in this work moves beyond an instrumental view of technology, framing ICT as a learning environment capable of reshaping cognitive processes, access to knowledge, and forms of participation.

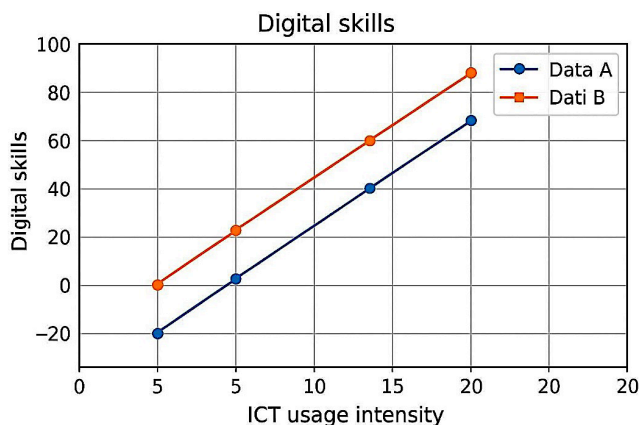
Technologies such as hypertext systems, interactive platforms, and assistive tools enable the construction of flexible, networked, and inclusive learning spaces. In these environments, learners with diverse abilities can access content through multiple modalities and engage actively in knowledge construction.

Beyond the screen, analyzes the role of ICT in contemporary schools, highlighting their impact on inclusion, personalization and methodological innovation.

New technologies – from hypertext to hypermedia, from interactive platforms to assistive technologies – contribute to creating flexible and networked learning environments, in which students with different abilities can access content and actively participate in training processes.

The relationship between ICT use intensity and digital skills level. The graph (Fig. 1) shows the comparative trend of two groups (Data A and Data B) in a path of progressive development of skills, highlight-

ing how the increase in exposure to digital technologies corresponds to a significant and differentiated growth in digital skills.



2. Theoretical Framework

This study is grounded in an integrated theoretical framework:

- Mayer's Cognitive Theory of Multimedia Learning (2021): learning is enhanced when information is presented through coordinated verbal and visual channels, reducing cognitive overload and fostering meaningful processing.
- Universal Design for Learning (UDL): emphasizes multiple means of representation, action, and engagement to ensure accessibility and inclusion.
- Lévy's concept of Collective Intelligence (1998): knowledge emerges through distributed, collaborative processes supported by digital environments.
- De Kerckhove's Brainframes (1991): technologies reshape cognitive architectures and influence how individuals think and learn.

This framework supports the interpretation of ICT not merely as tools, but as epistemic environments that mediate learning.

3. ICT Use and Digital Competence Development

Figure 1 illustrates the relationship between intensity of ICT use and development of digital competencies.

- Data A refers to a group exposed to structured, pedagogically guided ICT integration.
- Data B refers to a group with informal or unstructured exposure to technologies.

The trend shows that increased and pedagogically guided exposure leads to significantly higher levels of digital competence, confirming the importance of intentional instructional design.

4. ICT, multimedia and inclusion

ICT promotes multisensory, interactive and customizable forms of communication, expanding the possibilities of access and participation for students with Special Educational Needs (SEN), Specific Learning Disorders (SLD), and sensory or cognitive or motor disabilities. The conscious adoption of compensatory tools (speech synthesis, mind maps, audio-books, IWB, video editors) and the use of active methodologies (learning by doing, cooperative learning, digital storytelling) make it possible to improve the quality of learning and the involvement of the entire class.

Run-in Heading in Bold. Multimedia is not just a set of tools, but a cultural paradigm that integrates different languages (text, image, audio, video) and promotes complex, transdisciplinary and personalized cognitive paths.

Lowest Level Heading. The interactivity and flexibility of ICT require a renewed teaching role, centred on design, facilitation and multidimensional assessment. From a theoretical perspective, multimedia environments align with Mayer's principle of dual coding and with UDL guidelines, enabling differentiated access to content. The integration of textual, visual, and auditory languages supports diverse cognitive styles and enhances comprehension.

The adoption of compensatory tools (speech synthesis, concept mapping, audiobooks) and active methodologies (cooperative learning, digital storytelling, learning by doing) allows for:

- personalization of learning pathways
- increased engagement and motivation
- reduction of cognitive barriers

Consequently, the teacher's role evolves toward instructional designer, facilitator, and evaluator of multidimensional learning processes.

5. Methodology

The study adopts a multiple case study approach within a research-action framework. This design was chosen to investigate the impact of ICT integration in real educational contexts while simultaneously promoting pedagogical innovation.

6. Sample and Case Selection

The research includes 6 case studies conducted in lower and upper secondary school contexts.

Selection criteria:

- presence of students with SEN, SLD, ADHD, or sensory disabilities
- availability of digital infrastructure
- teachers' willingness to engage in reflective practice

7. Data Collection Tools

Data were collected using mixed methods:

- Validated questionnaires (adapted from DigCompEdu framework) to measure digital competence and engagement
- Structured classroom observations focusing on participation, interaction, and task completion
- Semi-structured interviews with teachers and students
- Learning analytics (platform usage data, task completion rates)

8. Data Analysis

- Quantitative data were analyzed using descriptive statistics and pre/post comparisons
- Qualitative data were analyzed through thematic analysis, identifying recurring patterns related to inclusion, participation, and motivation

9. Educational Applications and Case Study Results

Rather than listing technologies, this study examines their integration into micro-designed learning interventions.

10. Micro-Project Examples

- Case 1 (ADHD – Kahoot! + cooperative learning): use of gamified quizzes to enhance attention and engagement
- Case 2 (SLD – Coggle + speech synthesis): concept mapping to support reading comprehension
- Case 3 (sensory disability – Padlet + video content): multimodal content sharing for accessibility
- Case 4 (mixed class – Mentimeter): real-time feedback and inclusive participation
- Case 5 (language disorder – Wordwall): structured vocabulary reinforcement
- Case 6 (cognitive delay – digital storytelling tools): narrative competence development

11. Quantitative Results

Key findings (pre/post intervention):

- Increase in active participation: +32% average across cases
- Improvement in task completion rates: from 68% to 87%
- Growth in digital competence (DigCompEdu indicators): +28%
- Reduction in off-task behavior (ADHD case): -40%

12. Qualitative Results (Thematic Analysis)

Emerging themes include:

- Perceived inclusion: students reported feeling more involved and capable
- Multimodal accessibility: availability of multiple formats reduced learning barriers
- Collaborative learning: increased peer interaction and mutual support
- Teacher transformation: shift toward facilitation and reflective practice

13. Contribution to Literature

The study addresses a gap in existing literature: while many works describe ICT tools, fewer provide empirical evidence on their impact within structured micro-designs for inclusion. This research contributes by connecting specific tools, pedagogical design, and measurable outcomes.

14. Conclusion

The integration of ICT in schools should not be seen as an optional addition, but as a paradigm shift necessary for truly inclusive teaching. The use of multimedia tools and the transition to multidimensional assessment make it possible to enhance the different abilities of students, transforming the classroom into a dynamic digital ecosystem. Ultimately, "Beyond the bench" suggests that technological innovation acquires value only if guided by a solid pedagogical vision capable of putting the dignity of the person at the center.

ICT integration represents a paradigmatic shift rather than an optional enhancement. When guided by a solid pedagogical framework, technologies enable inclusive, flexible, and learner-centered environments.

The findings demonstrate that:

- the effectiveness of ICT depends on intentional design
- inclusion improves when multiple access channels are provided
- digital environments support both cognitive and social dimensions of learning

Ultimately, technological innovation acquires educational value only when it is anchored in a vision that places the dignity and potential of each learner at the center.

Keywords

ICT; School Inclusion; Multidimensional Assessment; Assistive Technologies; Gamification.

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ARTIFICIAL INTELLIGENCE-MEDIATED COMMUNICATION: INFRASTRUCTURES FOR DIGITAL DEMOCRACY AND DIGITAL ENTREPRENEURSHIP

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Abstract

Within the Human-Artificial Intelligence-Environment dynamical system, *Communication*, by means of a semiotics of language and knowledge, has been integral to the emergence of Artificial Intelligence (AI). Pursuing an expansion of the Computer-Mediated Communication's (CMC) theoretical domain, this paper positions itself in dialogue with Artificial Intelligence-Mediated Communication (AI-MC) and Human-Machine Communication (HMC). AI-MC refers to interpersonal communication processes in which intelligent, computational, agents operate on behalf of a communicator (sender and receiver) by modifying, augmenting, or generating messages to accomplish communicative or interpersonal goals (Hancock, 2020). HMC refers to artificial intelligence as a communicative subjectivity with which interaction occurs, rather than merely as a *medium*, i.e., the subject matter of communication (Gunkel, 2024; Gunkel, 2016; Guzman, 2018).

From this dialogue, AI-mediated communication is proposed as an infrastructural nexus for *digital democracy* and *digital entrepreneurship*, through which democratic participation, the polarisation of public discourse [Jha & Singh, 2025) and e-governance, alongside digital entrepreneurial processes (Hajli et al., 2025), unfold within economic and semiotic *value co-creation*. An analytical framework for AI-medi-

ated communication infrastructures is delineated, wherein *AI Literacy* constitutes a primary competency and is examined across three levels within the Human–Artificial Intelligence– Environment dynamical system: (Hancock, 2020) the technical-operational, (Gunkel, 2024) the semiotic-cognitive, and (Gunkel, 2016) the socio-economic level of value and governance. This paper articulates the nexus between communication, digital democracy and entrepreneurship as infrastructural in AI-mediated environments, outlining a conceptual ecosystem for value co-creation between human and artificial communicative subjectivities.

Keywords

Communication; Digital Democracy; Digital Entrepreneurship; Artificial Intelligence Literacy; AI-Mediated Communication Infrastructures.
Value Co-Creation

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“WHAT IF I FAIL?”: FINDINGS FROM A SURVEY OF ITALIAN HIGH SCHOOL STUDENTS ON FRUSTRATION TOLERANCE AND EMOTIONAL SELF-EFFICACY

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Introduction

Frustration tolerance (FT) and emotional self-efficacy (ESE) represent key psychological resources for adolescent well-being and adjustment. However, their distribution within the school context remains poorly documented at the level of individual measurement indicators. Through an item-level analysis, the present study aims to describe FT and ESE levels in a sample of Italian high school students, examining the relationships between the two constructs and their association with age. The survey was carried out as part of a project aimed at strengthening the educational alliance among teachers, students, and parents.

1. Methods

Cross-sectional research design. A total of 467 high school students completed (A) the Frustration Discomfort Scale (FDS; 28 items, 4 subscales of 7 items each; mean $\omega = .916$), and (B) the Emotional Self-Efficacy scale (ESE; 8 items, $\omega = .846$). Both questionnaires use a 5-point Likert-type response format.

2. Results

Item-level analysis was conducted using as the high endorsement threshold the percentage of respondents who selected the two highest

values on the 5-point Likert scale [$\text{frq}(4) + \text{frq}(5); \geq 50\%$]. The *Entitlement* subscale (FDS-ENT; $M = 24.34$) and the *Emotional Intolerance* subscale (FDS-EI; $M = 23.12$) showed the most critical profiles, with four and two items out of seven exceeding this threshold, respectively; an additional 2 items on the ENT subscale and 4 items on the EI subscale showed cumulative frequencies approaching the 50% threshold. The *Achievement Frustration* subscale (FDS-ACH; $M = 23.31$) also showed elevated values on two items and moderate values on four others. *Discomfort Intolerance* (FDS-DI; $M = 19.22$) yielded the lowest values. Regarding ESE ($M = 22.16$), 55.5% of students reported poor ability to manage reactive anger, and difficulties in managing emotions in stressful situations with values near the 50% threshold. ESE was negatively correlated with the FDS total score ($r = -.40, p < .01$) and with all its subscales. Neither construct showed significant associations with age.

3. Conclusions

The sample exhibited elevated levels of frustration intolerance – particularly in the Entitlement, Emotional Intolerance, and Achievement Frustration dimensions – associated with low emotional self-efficacy. The negative correlation between the two constructs ($r = -.40$) suggests that students with greater frustration intolerance tend to perceive themselves as less effective in managing their emotions. The absence of associations with age indicates that these difficulties are consistent across different school years, highlighting the need for structured psychoeducational interventions at all levels of secondary education aimed at enhancing emotional regulation and frustration management skills. Such interventions would have positive implications for both student well-being and the development of key competencies, including “learning to learn”, initiative and entrepreneurship, and civic and social skills.

Conflict of Interests. The authors declare no conflict of interest.

Ethical Approval. This study was approved by the school administration of the participating institution, and written informed consent was obtained from all participants and/or their legal guardians. All procedures complied with the ethical standards of the National Research Council and with the 1964 Declaration of Helsinki and its subsequent amendments.

Keywords

Frustration Discomfort Scale · Emotional self-efficacy · Emotion regulation · Irrational beliefs · REBT · Secondary school · Italian adolescents · Key competencies

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SEVEN-AI: GENERATIVE ARTIFICIAL INTELLIGENCE FOR UNIVERSITY ORIENTATION

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1. Introduction

The integration of generative AI (GenAI) into decision support systems represents a paradigm shift from traditional rule-based expert systems. While older models relied on rigid logic, Large Language Models (LLMs) enable fluid interaction and psychological profiling based on semantic nuances previously difficult to capture. The ability of LLMs to synthesize vast datasets and provide transparent explanations is essential for students making critical life choices. Generative models act as personalized tutors, adapting content to the user's cognitive profile. Recent literature investigates how these systems “infer” personality traits (e.g., Big Five or RIASEC models) from free-form text, making profiling more dynamic and less stressful than traditional psychometric tests. While recommendation systems for higher education exist, few integrate a generative component to create empathetic dialogue. Systems at the University of Florida and the Technical University of Munich have shown that GPT-4-based chatbots can increase student satisfaction by 20% compared to manual navigation. This study evaluates SEVEN-AI, a system utilizing Google Gemini APIs to support post-secondary orientation. The system identifies correlations between self-reported aptitudes and degree programs at the University of Salerno, providing two outputs: an “optimal”

choice (high current compatibility) and an “ambitious” choice (aimed at stimulating potential).

2. Theoretical and Methodological Framework

The framework draws on Flow Theory, focusing on the balance between challenges and skills. Activities where skills meet high interest result in “Synergy” or Flow. This is integrated with Self-Efficacy Theory, prompting students to assess their belief in their ability to execute necessary actions for specific results. Finally, a Skills Assessment matrix maps personal resources into four quadrants to identify an ideal “development zone”, avoiding paths leading to anxiety or boredom.

Methodologically, SEVEN-AI utilizes a digital questionnaire where students provide free-text descriptions of their interests and perceived competencies. A Google Apps Script anonymizes this data before sending it via API to Google Gemini. The prompts are structured to guide the LLM as a semantic inference engine: it maps the user’s narrative onto the theoretical matrix by weighing intrinsic motivation against self-efficacy. The “optimal choice” is generated by identifying programs where the student’s current skills and interests intersect most strongly. The “ambitious choice” identifies programs with high interest where the “challenge” slightly exceeds current “skills”, encouraging growth within the student’s “proximal development zone”.

3. Empirical Results

The system was pilot-tested with **150 secondary school students** (aged 15-19) during the *UnisaOrienta Experience 2025-2026*. Participants evaluated the system’s output using a 4-level Likert scale (1 = low, 4 = high). Quantitative results indicate high alignment:

- **Profile Accuracy:** Students reported a mean score of **3.7/4** regarding how well they recognized themselves in the AI-generated profile.

- **Optimal Choice Relevance:** The “first choice” recommendation received a mean score of **3.13/4**.
- **Ambitious Choice Relevance:** The “ambitious” recommendation received a mean score of **2.84/4**.

Qualitative feedback from open-ended responses was also overwhelmingly positive, highlighting the system’s ability to provide personalized reflections that traditional tests often overlook.

4. Limitations, Ethics, and Future Work

Despite positive results, the use of LLMs carries risks of algorithmic bias and “hallucinations.” To mitigate this, SEVEN-AI is framed as a reflective tool rather than a diagnostic one. Data privacy is ensured through pre-processing anonymization, and no sensitive personal identifiers are shared with the API. Future research will involve longitudinal follow-ups to track the academic progress and retention rates of these students, determining if AI-driven orientation correlates with long-term academic success and reduced dropout rates.

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AI FOR INCLUSIVE TEACHING? WHAT EXPLAINS TEACHERS' USE OF ARTIFICIAL INTELLIGENCE TO SUPPORT STUDENTS WITH SPECIAL EDUCATION NEEDS IN ITALY AND EUROPEAN UNION

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Artificial Intelligence (AI) enables forms of instructional personalization by adapting content, feedback, and learning pathways on the basis of students' performance (Pellegrini & Sebastiani, 2024). This potential is particularly relevant for students with Special Educational Needs (SEN), as AI can support accessibility, communication, and the adaptation of cognitive demands (Pagliara, 2024; Zingoni et al., 2021). Rather than acting only as a compensatory tool, AI may foster participation, autonomy, and engagement, contributing to a shift toward more flexible and inclusive learning environments (Fiorucci, 2024; Berizzi, 2017). However, its educational impact depends on how teachers integrate these technologies within pedagogical practices, positioning AI as a tool for instructional decision-making rather than mere technical support, also considering ethical and instructional implications (D'Alonzo 2024; Panciroli & Rivoltella, 2023).

The adoption of AI in education depends primarily on teacher-related factors (Zhang et al. 2023). The Technology Acceptance Model (TAM) explains technology use as driven by perceived usefulness and perceived ease of use, which shape attitudes and behavioural intentions (Davis, 1989). Research has extended TAM by highlighting the role of beliefs, self-efficacy, and professional context in shaping teachers' responses to innovation (Ching & Jamaludin, 2025). Within this framework, beliefs about AI and perceived instructional value directly inform the selection of explanatory variables in this study, including beliefs,

professional learning, and psychological dispositions. In the case of AI, adoption involves not only usability considerations, but also evaluations of pedagogical value and implications for inclusion (Kong, 2024; Prasetya, 2024).

AI adoption reflects a combination of professional learning, psychological conditions, and beliefs. Targeted training – particularly on inclusive practices and SEN – is associated with higher levels of adoption (Yue et al., 2024), although existing programmes often remain focused on technical aspects (Foulger, et al., 2013). Self-efficacy and job satisfaction support engagement with innovation, while stress and change fatigue may hinder it (Oei, 2013; Ace & Parker, 2010). Finally, beliefs about AI represent the central driver: positive perceptions of its usefulness for personalization increase adoption, whereas concerns about bias, privacy, and pedagogical risks may limit its use (Ofosu-Ampong, 2023; Kim N.J. & Kim, M.K., 2022). Accordingly, the present study examines AI use for SEN as the outcome of a multidimensional configuration of these factors, rather than as a purely technical competence.

This study investigates the factors associated with teachers' use of AI to support students with SEN, adopting a comparative perspective between Italy and the European Union. Data are drawn from the OECD-TALIS 2024 teacher questionnaire. The analytical sample includes lower secondary teachers from Italy (3,874 teachers, representing approximately 168,000 teachers) and a pooled European Union sample (87,428 teachers, representing approximately 1.27 million lower secondary teachers).

The dependent variable is a dichotomous indicator of whether teachers reported using AI to support students with SEN. Descriptive findings reveal a paradoxical pattern: although overall AI adoption is lower in Italy (25%) compared to the EU average (32%), Italian teachers who use AI are significantly more likely to employ it for inclusive purposes (61% vs 39%). This suggests a stronger orientation toward pedagogical personalization among Italian AI users.

A series of binary logistic regression models was estimated following a theory-driven sequential approach: (1) general beliefs about AI, (2) specific beliefs about AI functionalities, (3) professional learning and background, (4) psychological and professional dispositions, and (5) an integrated model combining all predictors. Model fit was assessed using Cox & Snell and Nagelkerke pseudo- R^2 indices. Regression results show a clear divergence between the two contexts. At the EU level, the use of AI for SEN is multifactorial and robustly associated with a combination of variables. In the fully integrated model (Nagelkerke $R^2 \approx 0.22$), significant predictors include positive and negative beliefs about AI, teacher self-efficacy, and participation in professional learning specifically focused on SEN. In addition, specific beliefs related to AI's capacity to support individual students and adapt instruction remain significant, confirming the central role of perceived pedagogical usefulness. In contrast, the Italian model ($R^2 \approx 0.30$) does not retain statistically significant predictors in the fully integrated specification. Although some variables reach significance in intermediate models, none remain significant once all controls are introduced. This does not necessarily indicate the absence of relevant associations; rather, it suggests that, in the Italian case, no single factor shows robust explanatory power when considered jointly with the others. This result should be interpreted with caution, as it is likely influenced by the smaller analytical sample, which reduces statistical power and increases standard errors.

The findings of this study confirm that the use of AI to support students with SEN cannot be interpreted as a simply technical practice, but rather as the outcome of a configuration of pedagogical beliefs, professional learning, and psychological dispositions. In line with the TAM, the European results show that both positive and negative beliefs about AI, together with self-efficacy and targeted professional learning on SEN, represent stable and significant predictors of AI use for inclusive purposes. This suggests that teachers are more likely to adopt AI when

they perceive it as instructionally valuable and when they feel professionally equipped to integrate it into their practice.

At the same time, the Italian results require a more cautious interpretation. While descriptive evidence indicates a strong orientation toward inclusive uses of AI among Italian teachers who adopt these technologies, the regression analysis does not identify statistically significant predictors in the fully integrated model. This absence of significance should not be interpreted as the absence of meaningful relationships, but rather as a limitation related to the reduced number of valid cases in the Italian sample, which increases standard errors and reduces statistical power. In this sense, the Italian model does not suggest that explanatory factors are irrelevant, but that their effects cannot be robustly isolated when considered simultaneously.

This interpretation is further supported by the intermediate models, where some predictors – particularly beliefs about AI supporting students with SEN – do reach statistical significance. Taken together, these findings suggest that the Italian case is characterized by weaker statistical discriminability rather than by the absence of underlying mechanisms. Future research based on larger national samples or longitudinal designs would be necessary to more precisely estimate these relationships.

From a policy perspective, the results highlight the need to move beyond a merely technical approach to AI training. The European evidence indicates that effective adoption is associated not only with digital competence, but also with pedagogical beliefs and targeted preparation for inclusive teaching. In particular, professional learning activities specifically focused on SEN emerge as a key lever for fostering meaningful and sustained integration of AI. This suggests that teacher education programmes should integrate AI literacy with inclusive pedagogy, adaptive teaching strategies, and critical evaluation of AI-generated outputs.

Finally, some limitations should be acknowledged. First, the dependent variable is based on self-reported data, which may be affected by social desirability bias and differences in interpretation across respondents. Second, the study relies on secondary analysis of TALIS data, where variables are predefined and not specifically designed to capture AI use in special education contexts. Third, the smaller analytical sample for Italy limits statistical power and the generalizability of national-level findings. Despite these constraints, the study provides a robust comparative perspective and contributes to the emerging literature by emphasizing the central role of teacher-related factors in shaping AI-supported inclusive practices.

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FROM IMPLICIT THEORY TO ENTREPRENEURIAL PRACTICE: RELATIONSHIPS BETWEEN GROWTH MINDSET AND EUROPEAN KEY COMPETENCES

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Abstract

In recent years, increasing attention has been paid to the development of entrepreneurial competences within educational settings, particularly in light of the European EntreComp framework, which identifies entrepreneurship as a key competence for active citizenship and employability. At the same time, research has highlighted the importance of individuals' beliefs about the possibility of changing their intelligence and personal characteristics. In particular, the Growth Mindset Scale and the "Kind of Person" Implicit Theory Scale, developed by Carol Dweck (1999; 2006), distinguish between a "fixed" mindset – according to which abilities are innate and largely unchangeable – and a "growth" mindset, which recognizes the role of effort and experience in fostering improvement. This theoretical framework is rooted in the perspective of implicit theories of personality (Dweck, Chiu & Hong, 1995) and in subsequent research on mindset and its effects in educational and motivational contexts (Blackwell, Trzesniewski & Dweck, 2007; Claro, Paunesku & Dweck, 2016). Understanding the link between growth mindset and entrepreneurial competences is therefore particularly relevant for the design of effective educational interventions.

The present study involved a total sample of 156 participants, including 30 Regional Civil Service volunteers and 126 students from a Technical Technological Institute. The main objective was to analyze the level of perceived entrepreneurial competences in the two groups,

assess the prevalence of a growth mindset with respect to both intelligence and personal characteristics, and explore the relationships between these variables. A cross-sectional research design was adopted. Quantitative data were collected through the online administration of standardized questionnaires and a socio-demographic form, and analyzed using descriptive statistics, group comparisons, and correlation analyses. The instruments included a self-assessment test of entrepreneurial competences inspired by the European EntreComp framework, structured around 15 competences (such as spotting opportunities, creativity, vision, ethical and sustainable thinking, motivation and perseverance, mobilizing resources, planning and management, coping with uncertainty and risk, working with others, and learning through experience); the Growth Mindset Scale (Dweck, 1999; 2006), consisting of three items measuring beliefs about the malleability of intelligence; and the "Kind of Person" Implicit Theory Scale (Dweck, 1999), composed of eight items assessing beliefs about the possibility of changing one's fundamental personal attributes. In both mindset scales, higher scores indicate stronger endorsement of a growth mindset.

Overall, the results show medium-to-high levels of self-assessed entrepreneurial competences, with particularly high scores in areas related to teamwork, motivation and perseverance, and opportunity recognition. The weakest perceived areas mainly concern financial and economic competences and the ability to mobilize resources. Regarding mindset, the majority of participants displayed a moderate to high growth orientation, both in relation to intelligence and to the possibility of changing core personal characteristics. Civil Service volunteers tended to report slightly higher levels in certain transversal competences, such as autonomy, responsibility, and initiative, compared to students. Correlational analyses further revealed a positive relationship between growth mindset and perceived entrepreneurial competences, consistent with previous findings in the literature (Blackwell et al., 2007;

Claro et al., 2016): higher mindset scores were associated with greater self-efficacy, perseverance, planning ability, and openness to risk. These findings confirm the role of growth mindset as a relevant individual factor in the development and perception of entrepreneurial competences. The results suggest that educational and training interventions aimed at promoting an incremental view of intelligence and personality, in line with Dweck's theoretical perspective (1999; 2006), may contribute to strengthening young people's self-efficacy, motivation, and entrepreneurial orientation. Integrating targeted mindset activities into school curricula and Civil Service programs may represent an effective strategy to foster personal empowerment, employability, and active, informed participation in social and economic life.

This study is limited by its cross-sectional design, which does not allow for causal inferences about the relationship between growth mindset and entrepreneurial competences. Moreover, the relatively small and non-random sample, based on self-report measures, may limit the generalizability of the findings and introduce potential response biases.

Keywords

entrepreneurial skills; Growth Mindset; Implicit Theory.

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TEACHERS' PERCEPTIONS AND USE OF GENAI-BASED WRITING TOOLS IN ASSESSMENT PRACTICES: A MIXED-METHODS STUDY

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1. Introduction

In recent years, the integration of artificial intelligence (AI) into educational settings has significantly altered the manner in which competencies are acquired and evaluated, notably impacting teaching and assessment methodologies (Chakraborty, et al.2023; Markauskaite, 2022). This change involves more than just the introduction of new tools; it also affects the role of the teacher and the learning process more deeply. Writing is one of the skills most affected by this transformation, as it is a complex process integrating linguistic, cognitive, and metacognitive dimensions (Cornoldi, et al.2018). AI-based writing tools are spreading rapidly, offering support in idea generation, text revision, and managing feedback. Using these tools for self-assessment opens up interesting possibilities, as students can receive immediate guidance while developing greater autonomy. However, these opportunities are accompanied by significant challenges, including the potential for writing to become less authentic and concerns relating to academic integrity (Zimotti et al., 2024). Therefore, it is crucial to understand how these tools are perceived and utilised in teaching practice. Against this backdrop, the present study aims to investigate how teachers perceive and utilise GenAI-based writ-

ing tools in assessment practices and writing instruction. The objective is to understand how familiarity with such tools and the importance attributed to assessment choices influence teachers' perceptions and practices.

2. Exploratory study

This exploratory study adopted an integrated mixed-methods design (Creswell, 2013; Tashakkori, 2009), and was conducted between January and February 2025. Qualitative and quantitative data were collected simultaneously. This research aimed to provide an in-depth reflection on the potential of AI-assisted writing tools within school assessment practices. Specifically, the study explored the association between the weight attributed to the choice of assessment tools and the use of software tools, and perceptions of the usefulness of GenAI in writing learning processes, as well as several operational dimensions related to their use. These include preferences for specific self-correction tools, the writing skills for which GenAI is considered most useful, and previous experience of teaching with such technologies. The sample consisted of 549 teachers enrolled in secondary school qualification courses at Telematic University of Pegaso in Italy.

In the questionnaire, Q1 refers to the perceived importance attributed to the choice of assessment tools, Q2 measures the actual frequency of use of digital/software tools in teaching practice, while Q3, Q6, and Q7 respectively indicate preferred types of writing support tools, the writing skills in which GenAI is considered most useful, and prior teaching experience with GenAI-based technologies. Although the study adopted an integrated mixed-methods design, the present paper focuses exclusively on the quantitative (inferential) analyses. Qualitative data, including open-ended responses, were collected but are not examined in the present work.

While descriptive statistical analyses were presented in a previous study (Agrati & Beri, 2025), the present work employed inferential

analyses (Pearson correlation and ANOVA) to examine whether familiarity with these tools and the importance attributed to assessment tools influence perceptions and practices related to the use of GenAI.

The results show that the use of software tools (Q2) is significantly correlated with the perceived usefulness of GenAI for both learning and writing ($r = .29$ and $r = .27$ respectively, both $p < .001$), while the weight attributed to the choice of assessment tools (Q1) shows positive but weak associations ($r = .12-.16$, both $p < .01$). ANOVA analyses indicate that Q1 does not differ significantly according to the preferred tool, writing skill or GenAI experience, suggesting limited influence. Conversely, Q2 shows significant differences across all three factors (Q3: $F = 3.51$, $p = .015$; Q6: $F = 4.24$, $p = .006$; Q7: $F = 5.41$, $p = .005$), indicating that greater use of software tools is associated with a slightly stronger preference for certain tools, a more evident practical application of GenAI in specific writing skills and a higher likelihood of having previously taught with these technologies. However, the effect size remains small ($\eta^2 \leq .023$).

Although statistically significant, the observed effects are consistently small, suggesting that the influence of digital tool familiarity on teachers' perceptions is limited in magnitude. From a practical perspective, this indicates that even modest exposure to software tools may shape pedagogical attitudes toward GenAI, but is unlikely to produce substantial changes in teaching practice without broader institutional support and targeted professional development. While this study did not directly address issues such as academic integrity and writing authenticity, the findings suggest that familiarity with GenAI tools alone plays only a limited role in shaping teachers' responses to these broader challenges

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AN ANALYSIS OF ‘ADULTESCENCE’ PARENTING: THE RELATIONSHIP BETWEEN SOCIAL MEDIA ADDICTION AND EDUCATIONAL PERFORMANCE

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Abstract

Contemporary educational literature has widely recognised the family as the primary educational institution, a place for the transmission of values, behavioural models and *life skills* (Rivoltella, 2010). However, the pervasive spread of *social media* is redefining the boundaries and methods of parental educational influence, introducing new variables into the parent-child dyad. The paradigm of parenthood is currently undergoing a phase of profound identity reconfiguration, marked by the emergence of the ‘adultescent’ adult. This construct describes an individual who, shunning conflict and the responsibility of setting boundaries, remains in a state of psychological immaturity and exhibits consumption patterns typical of younger age groups (Pellai, 2024). As theorised by Vittorino Andreoli (2021), the crisis of adult authority is not merely an absence of power, but a ‘metamorphosis of desire’ that drives parents to seek narcissistic validation in the very same digital spaces frequented by adolescents. This generational overlap generates an educational fragility that Stefania Andreoli (2018) identifies in the adult’s difficulty in acting as a ‘third-party’ regulator, transforming the primary bond into an emotional and symbiotic co-dependence (Pellai & Tamborini, 2024) also emphasise

how this *technoference* (technological interference) acts as a “cognitive hijacking” that deprives the child of the gazes and words necessary for the symbolisation of reality, compromising the function of the “secure base”. The phenomenon of *digital parenting* has been investigated in relation to specific practices such as *sharenting*, i.e. the systematic sharing of content relating to children (Andreoli, 2021). Indeed, international research has highlighted how *social media* represent spaces for identity negotiation for parents, but also arenas for the emergence of implicit educational models (Mironiuk, 2024). Nevertheless, the literature still lacks analytical frameworks specifically dedicated to the systematic observation of the intersections between parents’ *social* self-representation and the informal educational-didactic dimension. This study aims to address this area by providing an initial framework for understanding the phenomenon of digital adulthood, exploring whether and to what extent this existential stance manifests itself in observable behaviours that may also affect the educational environment in which children’s learning processes take shape.

From a methodological perspective, the study adopts an integrated and sequential research design. The preparatory phase involved a *systematic review* conducted on the ERIC, JSTOR and Scopus databases, strictly following the PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) protocol as an operational guide to ensure the transparency and replicability of the literature review (Page et al., 2020). This approach enabled the systematisation of the existing literature on narcissistic parenting *technoference*, sharenting and digital forms of parental self-representation, ensuring that the selection of sources followed objective and verifiable inclusion and exclusion criteria (Moher, 2009). The search of specialist databases was structured using Boolean operators designed to maximise the relevance of results in the fields of educational sciences and developmental psychology (Gough, 2017). The framework used for the study of *Instagram* posts was structured on the

basis of Krippendorff's (2019) *content analysis* criteria, assessing variables such as the aestheticisation of the self, the frequency and typology of *sharenting*, the performative representation of family life and 'narrative fragmentation' understood as the interruption or reconfiguration of educational activity for the sake of digital documentation. Sampling was carried out through *purposive sampling* of 100 public profiles, in full compliance with GDPR 2016/679 through the anonymisation of data and the blurring of the physical features of minors. The inclusion criteria concerned the public visibility of the profile, the recurrent presence of parenting-related content, explicit or implicit references to family life and the absence of exclusively commercial purposes. The third phase involved an aggregate and interpretative comparison between the patterns that emerged from the Instagram content analysis and the INVALSI 2023/2024 data, extracted from the public databases of the National Institute for the Evaluation of the Educational System. This phase did not involve individual-level matching between specific Instagram profiles and the school performance of individual children. Rather, the comparison procedure, guided by the Constant Comparative Analysis model (Glaser & Strauss, 2017) was used to situate the observed digital parenting patterns within the broader national evidence on logical-linguistic fragilities, avoiding causal inference or direct attribution to individual pupils.

The results obtained highlight recurrent patterns of digital adulthood characterised by the aestheticisation of the adult self, the frequent exposure of family life, *sharenting* practices and narrative fragmentation. When read alongside the INVALSI 2023–2024 evidence, these patterns suggest an exploratory association between parental hyperconnection and the possible impoverishment of verbal stimulation, attentional continuity and symbolic mediation within the home environment. The study does not claim a direct causal or predictive relationship between the caregiver's social media dependency and children's school achievement; rather, it proposes an initial analytical framework for interpreting

digital adulthood as a potential factor of educational role fragility. In conclusion, the research suggests that digital adulthood is not merely an aesthetic trait, but a possible indicator of a weakening of the primary educational process. Future prospects point to the need to implement *Digital Parenting protocols* aimed at restoring the symbolic boundary between adult and child, promoting a relational ecology that protects the cognitive development of younger generations.

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MARINE DEBRIS DETECTION FROM SATELLITE IMAGES USING DEEPLABV3 WITH RESNET BACKBONE

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Abstract

Marine debris has become a significant environmental challenge that threatens marine ecosystems and coastal communities. Traditional monitoring methods are often slow and labor-intensive, making automated detection systems essential. This study proposes a deep learning-based approach for detecting marine debris using the DeepLabV3 semantic segmentation architecture trained on the MARIDA dataset. The model is trained to classify multiple debris categories present in satellite imagery and is evaluated using standard segmentation metrics such as precision, recall, and F1-score. Experimental results demonstrate that the proposed model effectively identifies debris regions while maintaining high segmentation accuracy across several classes. A lightweight deployment pipeline using FastAPI is also implemented to enable real-time inference and visualization. The proposed system highlights the potential of deep learning-based remote sensing techniques for scalable marine debris monitoring and environmental protection.

Index Terms – Marine Debris, Semantic Segmentation, DeepLabV3, ResNet, Satellite Imagery, mIoU, Environmental Monitoring.

1. Introduction

Marine debris has become one of the most critical environmental issues affecting oceans across the world. Various types of floating waste, including plastic fragments, abandoned fishing gear, and other human-generated materials, accumulate in marine environments and remain there for extended periods. These pollutants negatively impact

marine life, degrade coastal habitats, and create challenges for activities such as fishing, shipping, and tourism.

Understanding the distribution and movement of marine debris is essential for developing effective pollution management strategies. Traditionally, monitoring efforts rely on field surveys, aerial observations, and ship-based inspections. Although these approaches can provide useful localized information, they require significant resources and are not suitable for monitoring large ocean areas continuously.

Satellite remote sensing offers a promising alternative for large-scale environmental monitoring. Modern Earth observation satellites, including Sentinel-2, capture high-resolution multispectral imagery that provides valuable information about ocean surface conditions. However, the large volume of satellite data generated daily makes manual interpretation slow and impractical.

Recent advances in deep learning have significantly enhanced automated image analysis capabilities. Convolutional Neural Networks (CNNs) have achieved remarkable success in various computer vision applications such as object detection,

classification, and semantic segmentation. When applied to satellite imagery, these models can learn complex spatial and spectral features that help distinguish marine debris from surrounding water bodies or other natural ocean elements.

In this study, we present a deep learning-based framework for detecting marine debris using the MARIDA satellite dataset. The dataset contains multispectral image patches derived from Sentinel-2 scenes, each annotated with different marine surface categories. The proposed method trains a neural network model to analyze these image patches and identify patterns associated with debris-related classes.

The main contributions of this work are summarized as follows:

- Development of a deep learning-based marine debris detection system using the DeepLabV3 semantic segmentation architecture.

- Training and evaluation of the model on the MARIDA satellite imagery dataset for multi-class debris segmentation.
- Performance analysis using standard evaluation metrics including precision, recall, and F1-score.
- Implementation of a lightweight deployment pipeline using FastAPI for real-time prediction and visualization. The proposed approach aims to support automated monitoring systems that can assist environmental agencies in identifying and tracking marine pollution across large ocean regions.

The remainder of this paper is organized as follows. Section II reviews related work in marine debris detection and satellite image analysis. Section III describes the dataset preparation and methodology used in this study. Section IV presents the experimental results and performance evaluation. Section V discusses the conclusions and possible directions for future work, and Section VI provides the references used in this research.

2. Related work

Monitoring marine debris has traditionally depended on field investigations and manual observations conducted by researchers and environmental organizations. Although these approaches provide reliable information about pollution levels in specific locations, they require significant time and resources and are difficult to scale for monitoring large ocean regions.

The advancement of remote sensing technologies has enabled the use of satellite imagery for environmental observation. Satellite sensors can capture large areas of the Earth's surface, making them useful for studying ocean conditions, tracking pollution, and identifying floating objects on water surfaces. Several studies have explored the application of satellite data for detecting marine pollution and monitoring ocean surface phenomena.

In recent years, machine learning and deep learning techniques have become widely used for analyzing satellite imagery. These meth-

ods have been successfully applied to various tasks such as ship detection, oil spill identification, land cover classification, and environmental monitoring. In particular, Convolutional Neural Networks (CNNs) have shown strong performance in extracting meaningful spatial patterns from complex image data.

To support research in marine debris detection, the MARIDA dataset was developed as a benchmark dataset based on Sentinel-2 satellite imagery. The dataset contains labeled image patches representing different marine surface materials, including both natural ocean elements and debris related categories. This dataset enables supervised learning approaches for training models that can recognize debris patterns in multispectral imagery.

Recent studies using the MARIDA dataset have demonstrated that deep learning architectures can effectively identify debris-related features in satellite images. Despite these advancements, translating research models into practical monitoring systems that support automated detection and real-world deployment remains an active area of development.

In this work, we extend prior research by designing a complete processing pipeline that includes data preprocessing, deep learning model training, evaluation of model performance, and deployment through a backend service for automated prediction.

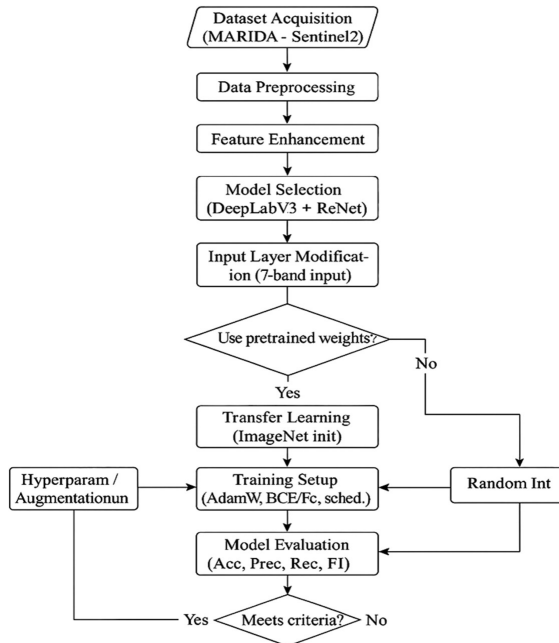
When considered collectively, existing studies highlight the importance of deep learning methods that can capture multi scale spatial features while also addressing dataset challenges such as class imbalance. Building on these insights, our work adopts a DeepLabV3-based approach and incorporates data augmentation, balanced training strategies, and evaluation across different label groupings to improve the detection of marine debris from satellite imagery. Recent studies have also explored transformer-based architectures and hybrid deep learning models for satellite image segmentation, demonstrating improved contextual feature extraction for complex ocean environments [21].

3. Methodology

This section explains the dataset preparation process, preprocessing pipeline, network architecture, loss formulation, and training configuration used in the proposed system.

A. Dataset Construction

The experiments carried out in this study utilize the MARIDA dataset, which serves as a benchmark dataset for marine debris detection using Sentinel-2 satellite imagery. The dataset contains multispectral image tiles extracted from larger satellite scenes and annotated with multiple categories representing different ocean surface materials.



Stage notes: Dataset = MARIDA Sentinel-2 patches. Preproc = band W , normalize, NaN-handling. Feature = NDVI, NDWI, FDI. Augmentation = Albumentations. Model = Modified DeepLabV3 c (Resnet), Input = adapt first conv for 7 channels. Transfer = optional ImageNet init. Train = AdamW, BCE/Focal loss, hybrid LR schedulers.

FIG. 1 – Overall workflow of the proposed DeepLabV3-based marine debris detection framework.

Each image tile corresponds to a specific region of the ocean surface and is assigned a label based on the dominant surface type observed in that area. These labels include both natural marine elements and human-generated debris categories. Such annotations make it possible to train supervised deep learning models capable of identifying pollution patterns from satellite data.

Two different labeling schemes are considered during experimentation. The first scheme contains fifteen detailed semantic classes that represent various marine surface materials. The second scheme groups these labels into five broader categories to simplify the classification problem and improve training stability.

To ensure efficient model training and compatibility with available computational resources, large satellite images are divided into smaller fixed-size tiles. These tiles are standardized to resolutions such as 256×256 or 512×512 pixels before being used as inputs to the neural network.

- Detailed (15 classes): clear water, foam, algae, plastic sheet, plastic fragments, fishing net, wood, ship wreck, vessel, seaweed dense, oil slick, seafoam, floating garbage, shadow, unknown.
- Simplified (5 classes): water, vegetation/algae, plastic/garbage, vessel/ship, other/debris.

B. Class Imbalance Handling

Marine debris datasets are highly imbalanced, with large portions of satellite imagery containing only water or natural ocean surfaces. As a result, models trained directly on such datasets may become biased toward dominant classes and fail to learn meaningful representations for rare debris categories.

To mitigate this issue, an imbalance-aware sampling strategy was incorporated during model training. A `WeightedRandomSampler` was used in the data loader to increase the sampling probability of underrep-

resented classes. This ensures that rare debris categories appear more frequently during training iterations and helps the model learn more balanced feature representations.

In addition, class weights derived from inverse class frequency were incorporated into the loss function. This weighting mechanism penalizes incorrect predictions of minority classes more strongly, improving the model's sensitivity to small debris objects and rare pollution categories.

Depending on GPU memory constraints, image tiles were standardized to sizes of 256×256 and 512×512 pixels. Additionally, class distribution was analyzed and rebalancing strategies were applied where necessary to reduce bias toward dominant classes.

C. Preprocessing and Augmentation

Prior to model training, several preprocessing operations are performed on the satellite imagery. Pixel values are first normalized to maintain consistent value ranges, which helps stabilize the learning process. Channel-wise normalization based on training set statistics is also applied to improve model convergence.

Since Sentinel-2 imagery provides multiple spectral bands, selected bands are used as input channels for the model. Experiments include the use of standard RGB bands as well as combinations incorporating the near-infrared band, which can provide additional information about ocean surface properties.

To increase the diversity of training data and improve the robustness of the model, data augmentation techniques are applied. These include geometric transformations such as horizontal flipping, vertical flipping, random rotations, and random cropping. In addition, photometric augmentations such as brightness and contrast variations are introduced to simulate changes in environmental and illumination conditions.

Finally, class balancing techniques are incorporated during training in order to address the uneven distribution of classes within the dataset.

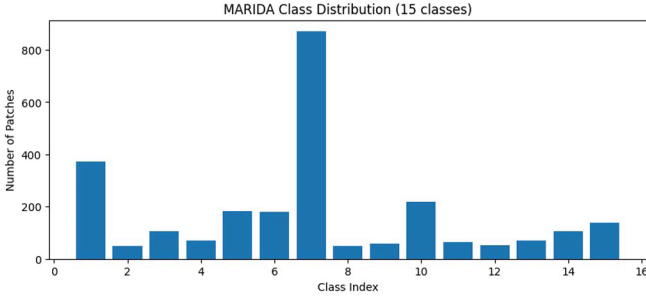


FIG. 2 – MARIDA class distribution (15-class).

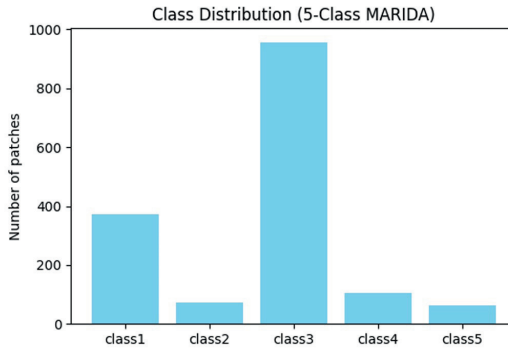


FIG. 3 – MARIDA class distribution (5-class).

D. Model Architecture: DeepLabV3 + ResNet

DeepLabV3 + ResNet The proposed framework utilizes DeepLabV3 as the semantic segmentation architecture, combined with a ResNet backbone for feature extraction. Both ResNet-50 and ResNet 101 variants are explored, using weights pre-trained on the ImageNet dataset to enable transfer learning.

Key architectural components include:

- **Atrous Spatial Pyramid Pooling (ASPP):** This module captures contextual information at multiple spatial scales by applying parallel atrous convolutions with dilation rates of 6, 12, and 18.
- **Backbone Network:** The ResNet backbone consists of multiple residual blocks that learn hierarchical visual features from the input im-

ages. To improve training stability, the earliest layers (initial convolution and first residual block) remain frozen during initial training epochs.

- **Decoder Module:** The decoder refines segmentation outputs by progressively up sampling feature maps using bi linear interpolation followed by convolutional operations.
- **Output Layer:** The final layer produces per-pixel class probabilities using a SoftMax activation function. In some experimental settings, Conditional Random Field (CRF) based post-processing was also explored to enhance boundary refinement.

E. Loss Functions and Optimization

Because marine debris classes are often underrepresented in the dataset, specialized loss functions are employed to improve model sensitivity to smaller or rare objects.

- **Composite Loss Function:** The total loss is defined as a weighted combination of categorical cross-entropy and Dice loss:

$$L = \alpha L_{CE} + \beta(1 - \text{Dice})$$

where $\alpha = 0.6$ and $\beta = 0.4$.

- **Class Weighting:** Inverse-frequency weighting is applied within the cross-entropy term to compensate for class imbalance.
- **Optimizer:** Model parameters are optimized using the Adam optimizer with weight decay of 1×10^{-4} . The initial learning rate is set to 1×10^{-4} and updated using a cosine annealing schedule with warm restarts.
- **Regularization:** Dropout with probability $p = 0.3$ is applied within the decoder layers, while batch normalization is used during backbone fine-tuning.
- **Early Stopping:** Training is stopped early if validation mIoU does not improve for 12 consecutive epochs.

F. Training Setup

The model training configuration is summarized as follows:

- **Hardware:** Training experiments were conducted on an NVIDIA GPU (e.g., Tesla V100 or RTX 3090). Batch size was selected between 8 and 16 depending on the input tile resolution.
- **Dataset Split:** The dataset was divided into training, validation, and testing subsets using an 80% / 10% / 10% split while maintaining balanced representation of debris density across regions.
- **Training Duration:** Models were trained for approximately 50–100 epochs, with checkpoints saved based on the best validation mIoU score.
- **Evaluation Metrics:** Model performance was assessed using pixel accuracy, class-wise precision and recall, F1- score, and mean Intersection-over-Union (mIoU).

4. Experiments and results

Experiments were conducted under both labeling configurations (15-class and 5-class) in order to evaluate model performance under different levels of semantic granularity. The proposed DeepLabV3 model was compared with two baseline approaches: a patch-level CNN classifier and the U Net segmentation architecture. All reported quantitative results correspond to the best checkpoint selected using validation based early stopping.

A. System Requirements

Hardware Requirements

- **Processor:** Intel Core i7 or equivalent
- **GPU:** NVIDIA RTX series GPU (recommended for faster training)
- **RAM:** Minimum 16 GB
- **Storage:** At least 50 GB available space

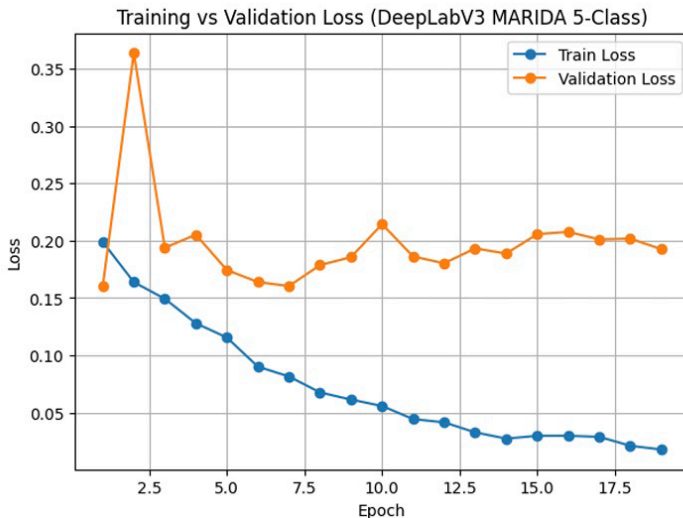
Software Requirements

- Python 3.9
- PyTorch Deep Learning Framework
- OpenCV for image processing
- FastAPI for backend deployment
- Jupyter Notebook for experimentation
- Matplotlib and NumPy for visualization and numerical computation

B. Evaluation Metrics

To measure model performance, several standard segmentation metrics were used:

- Pixel Accuracy: the proportion of correctly predicted pixels over the total number of pixels.
- Precision, Recall, and F1-score: computed per class and macro-averaged across all categories.
- Mean Intersection over Union (mIoU): the average IoU across all classes, used as the primary indicator of segmentation quality.



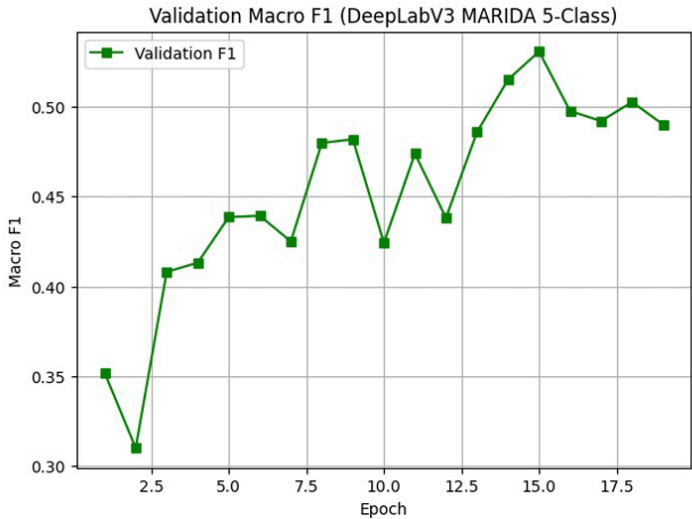


FIG. 4 – Training and validation curves for DeepLabV3 on the simplified 5-class MARIDA dataset. The decreasing training loss and the steady improvement in validation F1-score demonstrate stable convergence and good generalization.

C. Main Results

Table I presents the performance comparison between the baseline models and the proposed DeepLabV3 framework.

TABLE I: Overall performance comparison (representative).

Model	Pixel Acc (%)	mIoU	Mean F1
Patch-CNN (baseline)	82.4	0.61	0.68
U-Net (baseline)	89.1	0.79	0.82
DeepLabV3-ResNet (15-class)	88.0	0.78	0.80
DeepLabV3-ResNet (5-class)	94.2	0.87	0.89

- The simplified 5-class configuration achieves higher pixel accuracy and mIoU because similar debris subclasses are merged into broader categories, reducing classification ambiguity.

- The detailed 15-class setup is more challenging due to visual similarities between certain categories such as plastic fragments, foam, and algae.
- DeepLabV3 demonstrates improved segmentation performance compared to U-Net, particularly in detecting small debris objects and producing more precise boundary delineations due to its ASPP module and larger receptive fields.

D. Class-wise Performance (selected classes)

Table II shows the Intersection over Union values for selected classes under the 15-class configuration.

TABLE II: Class-wise IoU (15-class, selected).

Class	IoU	Class	IoU
Clear Water	0.92	Seaweed Dense	0.70
Plastic Fragments	0.69	Oil Slick	0.58
Plastic Sheet	0.62	Fishing Net	0.65
Ship / Vessel	0.85	Other Debris	0.60

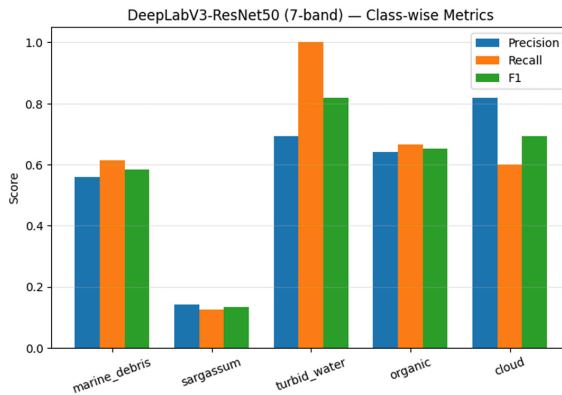


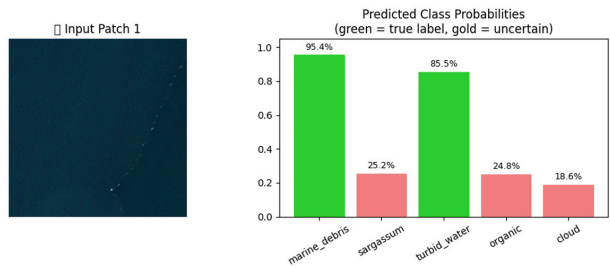
FIG. 5 – Class-wise precision, recall, and F1-score for the DeepLabV3-ResNet50 model. Higher scores are observed for dominant classes such as turbid water and clouds, while smaller or visually complex categories remain more challenging.

Important insights from the class-level analysis include:

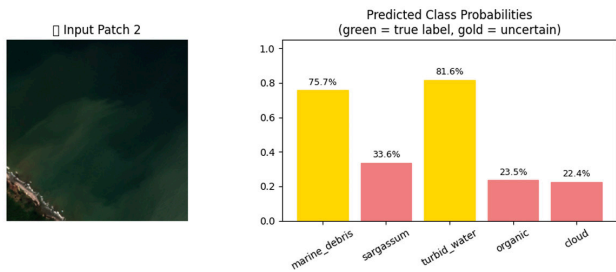
- Large and visually distinct objects such as vessels or continuous water regions achieve higher IoU values.
- Small debris items and low-contrast features such as thin plastic sheets or oil films remain more difficult to segment accurately.
- Additional improvements could be achieved using higher resolution imagery, expanded multispectral features, or boundary refinement techniques such as CRF post processing.

E. Qualitative Discussion

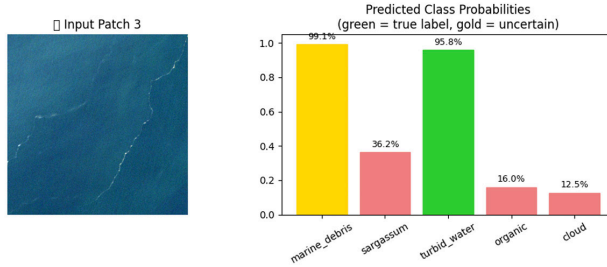
Visual inspection of the segmentation outputs provides additional insight into the behavior of the trained model.



(A) EXAMPLE 1 – Accurate detection of marine debris with high prediction confidence.



(B) EXAMPLE 2 – Successful identification of both marine debris and turbid water in complex coastal conditions.



(c) EXAMPLE 3 – Detection of linear debris accumulation patterns in open water.

FIG. 6 – Examples of qualitative model predictions showing in put image patches and predicted class probabilities. Green bars represent correct predictions, while gold indicates uncertain classifications.

Qualitative observations suggest that:

- The model effectively identifies debris clusters and vessel structures.
- False detections occasionally occur in regions affected by strong cloud shadows or surface glare.
- Temporal analysis using multi-date imagery may help distinguish transient environmental effects from actual debris accumulation.

F. Operational Considerations

For real-world deployment of marine debris monitoring systems, several practical considerations should be addressed:

- Automatic filtering of satellite tiles affected by clouds or strong sun-glint conditions.
- Prioritization of high-confidence predictions for rapid alerts, while uncertain predictions can be flagged for manual review.
- Integration with geographic information systems (GIS) to estimate debris coverage areas and support cleanup planning.

G. Real-World Deployment and Operational Use

To demonstrate the practical applicability of the proposed approach, a lightweight inference service was implemented using the FastAPI frame-

work. The deployment pipeline allows satellite image tiles to be uploaded through an API endpoint, where they are processed by the trained DeepLabV3 model to generate segmentation predictions.

The system performs the following steps:

- 1) Image preprocessing and normalization
- 2) Model inference using the trained DeepLabV3 network
- 3) Generation of segmentation masks
- 4) Visualization and output formatting

This architecture enables integration with external environmental monitoring platforms and geographic information systems (GIS). For example, satellite imagery collected from Earth observation missions can be automatically processed to identify potential marine debris accumulation zones.

Such automated monitoring systems could support:

- Marine pollution tracking
- Coastal cleanup planning
- Environmental policy monitoring
- Early detection of large debris patches

Because the model operates on individual satellite tiles, the system can scale to large geographic regions through distributed processing pipelines, making it suitable for continuous global marine monitoring.

H. Real-World Deployment and Operational Use

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5. Conclusion

This study presented a semantic segmentation framework based on the DeepLabV3 architecture with a ResNet backbone for detecting marine debris in satellite imagery. The proposed approach was evaluated using the MARIDA dataset under both detailed (15-class) and simplified (5-class) labeling schemes. Experimental results demonstrate that DeepLabV3 achieves strong segmentation performance and outperforms baseline CNN and U-Net models, with the simplified 5-class configuration providing higher accuracy and stability for large scale monitoring applications. Despite these promising results, challenges remain in detecting small or low-contrast debris objects and handling class imbalance within the dataset. Future work will focus on integrating multispectral and SAR satellite data, incorporating temporal satellite observations for debris tracking, and optimizing the model for efficient real-time deployment in environmental monitoring systems.

With these extensions, the proposed framework has the potential to become a valuable component of large-scale marine environmental monitoring and pollution response systems.

ACKNOWLEDGMENT

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THE PERFORMANCE–KNOWLEDGE GAP: AI, SOFT SKILLS, AND ENTREPRENEURIAL READINESS IN TECHNICAL HIGHER EDUCATION

Omar EL OTMANI and Mohammed ADLI

Revised Abstract

As Artificial Intelligence (AI) becomes increasingly embedded in higher education, growing concerns have emerged about its impact on students' cognitive engagement and entrepreneurial readiness. While the demand for human-centric competencies – particularly interpersonal communication, collaborative leadership, and autonomous critical reasoning – continues to rise, limited empirical attention has been paid to how AI-mediated learning environments affect their development in technical education. Drawing on a mixed-methods case study conducted at the École Supérieure de Technologie d'Oujda (Morocco), this study analyzes data from 191 undergraduate students enrolled in technical disciplines. Through classroom-based interventions, structured observation, and assessment of student assignments and project-based outputs, the research identifies a “performance-knowledge gap”, defined as the discrepancy between AI-assisted task completion and students' ability to independently develop, justify, and defend solutions. The study is theoretically grounded in the EntreComp Framework, which conceptualizes entrepreneurial readiness as a set of competences integrating cognitive, behavioral, and social dimensions. Within this framework, the “performance-knowledge gap” is interpreted as a misalignment between AI-assisted task performance and the actual development of entrepreneurial competences. Findings indicate that while AI tools enhance the efficiency and formal quality of student work, they may also mask deficits in cognitive depth and limit students' ownership of ideas.

This dynamic constrains the development of key competencies required for entrepreneurial initiative and innovation. In particular, deficits in communication, collaboration, and critical reasoning emerge as barriers to translating technical knowledge into viable entrepreneurial practice. However, despite the limited scope where these findings have been situated, they still offer indicative insights into broader transformations in AI-mediated technical education. Thus, the paper argues for a reconfiguration of technical curricula that systematically integrates soft skills as core components of learning rather than supplementary attributes. Such an approach repositions soft skills as central to entrepreneurial human capital formation in AI-mediated education.

Keywords:

AI, Soft Skills, Entrepreneurship, Employability, Higher Education

SILENCED DISTRESS: MENTAL HEALTH STIGMA AND SOCIO-RELIGIOUS MEANING-MAKING IN NIGERIAN DIGITAL MEDIA

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1. Introduction

Mental health disorders represent a significant global public health challenge. Nearly one billion people worldwide lived with mental disorders in 2019, with depression and anxiety among the leading contributors to the global burden of disease (Chen et al., 2022; Coelho et al., 2025). Despite the prevalence of mental health conditions, a substantial proportion of affected individuals do not receive professional treatment. Stigma remains one of the most persistent barriers to recognition, disclosure, and access to care, as social expectations and moral judgments often discourage individuals from acknowledging psychological distress or seeking professional support (Salami et al., 2025).

These challenges appear particularly pronounced in Nigeria, where structural limitations in mental health care intersect with culturally embedded interpretations of illness. Nigeria illustrates how structural and cultural factors intersect in shaping mental health experiences. The country faces a severe shortage of trained mental health professionals alongside limited public investment in psychiatric services (Pederson et al.2021; Saba, 2024).

Within many communities, psychological distress is frequently interpreted through socio-religious frameworks that attribute suffering to spiritual attack, divine punishment, witchcraft, or personal weakness (Pederson et al.2021; Saba, 2024; Ademowo, 2024). Such interpretations often connect mental illness with shame and moral failure, encouraging

concealment within families and delaying help-seeking (Festus, 2025; Nwedu & Ominiya, 2025).

Digital media increasingly shapes how people discuss and understand mental health in everyday life. Social media platforms function as spaces where individuals share experiences, seek information, and negotiate public understandings of psychological distress. These platforms bring together diverse actors, including mental health professionals, advocates, and individuals with lived experience, within shared communicative environments where cultural and biomedical interpretations of mental illness intersect (Christiansen et al., 2025).

Existing research documents the prevalence of mental health stigma in Nigeria and highlights the influence of spiritual and cultural interpretations of distress. Most studies approach stigma primarily as a belief system or a barrier to treatment. However, studies rarely examine how participants communicatively produce, negotiate, and contest stigma within contemporary media environments.

This study addresses that gap by examining Nigerian YouTube discussions in which mental health professionals, advocates, and individuals with lived experience reflect on psychological distress and social judgment. Rather than treating stigma as a fixed cultural attitude, the analysis approaches stigma as a communicative process that emerges through narrative framing, cultural references, and public dialogue.

Therefore, the study asks:

1. How is mental health stigma constructed and communicated in Nigerian digital media discussions of psychological distress?
2. How do socio-religious and cultural meanings shape explanations of mental illness and responses to help-seeking in these media texts?
3. How do mental health professionals, advocates, and individuals with lived experiences negotiate or challenge stigmatizing interpretations of mental illness in digital media spaces?

2. Methodology

Data Selection

The study analyzes 16 purposively selected YouTube videos published between 2018 and 2026 to capture continuity and change in public discussions of mental health. The material comprises approximately 156 minutes of spoken content and includes more than 30 clearly identifiable participants, alongside additional contributors in street interview segments. Participants include psychiatrists, psychotherapists, media presenters, advocates, and younger Nigerians discussing lived experiences, public perceptions, and pathways to care.

The analysis extends beyond the videos to include user comments. Incorporating comment sections allows the study to capture the participatory nature of YouTube, where meanings are negotiated through interaction rather than contained within the video itself. This broader dataset makes it possible to examine how audiences reflect, reproduce, and challenge socio-religious narratives of mental health in everyday discourse.

Thematic sufficiency was approached through depth, richness, and recurring patterns rather than a fixed numerical threshold. Repeated engagement with both video and comment data revealed consistent patterns across themes such as spiritual explanations, family shame, distrust of psychiatric care, digital resistance, and structural constraints. These materials function as analytically rich cases that support close interpretation rather than statistical representation.

3. Methodological Orientation

The study employs qualitative reflexive thematic analysis to examine patterns of meaning across the selected media texts. This approach supports close attention to how meanings are expressed within specific social contexts and is well suited for exploring how speakers interpret mental illness and describe responses to psychological distress (Ahmed,

et al. 2025). The analysis focuses on recurring narrative frames, cultural references, and explanatory models that participants draw upon when discussing mental health. Attention is given to references to spiritual explanations, family expectations, treatment pathways, and the authority of professional expertise.

Reflexive thematic analysis treats interpretation as an active process shaped through engagement between the researcher, the data, and the study's theoretical orientation. Themes are not treated as fixed features of the data but as patterns developed through sustained and careful engagement with the material (Byrne, 2022). Guided by an interpretivist and constructivist perspective, the analysis examines how participants describe their experiences and how shared meanings emerge in interaction (Byrne, 2022). The analysis followed an inductive, data-driven coding process. The material was open-coded to capture how participants described distress, stigma, and help-seeking, rather than applying pre-determined categories. Codes and themes developed iteratively through familiarization, coding, theme development, and refinement. Although the dataset includes audiovisual content and user comments, the analysis focuses on spoken discourse and narrative framing.

Moreover, through John F. Manzo's critique, the study treats stigma as a member's phenomenon rather than an imposed category (Manzo, 2004). The analysis attends to moments where participants name stigma, anticipate judgment, describe concealment, or reflect on social expectations. This approach allows stigma to emerge through participants' own accounts.

4. Analytical Procedure and Ethical Considerations

The analysis followed an iterative process. Initial viewing supported familiarization with the material, followed by open coding of segments addressing cultural explanations, social judgment, help-seeking, and professional credibility. Codes were then grouped into broader patterns, which

developed into themes through continued engagement with the data. Attention was given to moments of contestation, resistance, and translation between cultural and biomedical explanations. All materials were publicly available online while ethical care guided data use throughout. Names and identifying details were anonymized, and participants sharing personal experiences are described in general terms to reduce potential vulnerability. Personal disclosures were handled carefully, and no identifying details were included beyond what was necessary for the analysis.

5. Analysis and Findings

Across the media texts and their accompanying user comments, speakers approached mental health stigma less as a general social attitude and more as a framework for interpreting and managing psychological distress. Reflexive thematic analysis generated five themes that capture recurring patterns in the data.

6. Spiritual and Cultural Framing as a Default Explanation

Across the discussions, speakers frequently described mental distress through spiritual or moral explanations rather than biomedical ones. References to witchcraft, spiritual attack, or hostile family relations appeared as familiar cultural narratives through which distress became intelligible. In one interview, a psychiatric expert explained that individuals often attribute emotional difficulties to “village people”, witchcraft, or harmful intentions, thereby shifting the source of distress toward external spiritual forces. A similar interpretation appeared in a TVC News broadcast (TVC News, 2022), where a mental health advocate described how mental illness is often explained through spiritual warfare narratives involving “village people”, demonic possession, and the need for deliverance, sometimes accompanied by practices such as physically beating sufferers in attempts to cast out demons. Within these accounts, practices such as prayer sessions, deliverance rituals, or attempts to “cast

out" demons were presented as common responses to psychological distress. Furthermore, another psychologist referred to this pattern as "spiritual bypassing", describing cases where individuals redirect distress toward prayer, deliverance, or pilgrimage rather than seeking clinical care (TrustTV News, 2025)

This spiritual etiology, which also shaped treatment pathways, was vividly illustrated in a public talk where a speaker deconstructed Yoruba concepts of mental illness (*asiwere*), classifying them into madness from birth, generational illness, or "were afishe", meaning "someone placed a curse on you" (TEDx Talks, 2019). Another speaker similarly noted that when a child exhibits symptoms, parents' immediate response is often "God forbid is not your portion", followed by taking the individual to a "religious institution for prayers and fasting rather than a psychiatric facility" (TEDx Talks, 2022).

The pervasive nature of these beliefs was also reflected and critiqued in the digital public sphere. For instance, a YouTube commenter responding to one video pointed to the media's complicity, stating, "Nollywood say people are mad because they are evil. THAT IS THE MESSAGE!!!" (Zikoko, 2020).

Hence, this theme suggests that spiritual C-cultural explanations functioned as a default interpretive logic through which distress was rendered meaningful, while often delaying recognition of psychological or medical framings.

7. Stigma as Family Management, Concealment, and Moral Regulation

Speakers rarely described stigma as an individual attitude alone. Instead, they presented it as something managed within families and communities, where mental illness became linked to collective reputation. Participants connected mental illness to concerns about family image, recounting situations where a mentally ill relative was interpreted as evidence of moral failure, leading to silence and concealment.

Because mental illness was heavily stigmatized, some participants described adopting forms of performative wellness to protect themselves and their families. One interviewee captured this burden: "nobody around me really knew that I was going through it because I hid it really well... if you see my pictures, I was always smiling... but when I go back and I'm by myself... it felt like I was in a dark space" (Arise News, 2021). This account illustrates how stigma can compel individuals to maintain visible normalcy while privately experiencing distress.

This moral regulation also appeared highly gendered. One speaker highlighted that men expressing suicidal ideation are frequently met with the dismissive command to "man up be a man... stop being cowardly or selfish" (TEDx Talks, 2020). Here, masculine norms worked to suppress emotional disclosure and frame vulnerability as weakness.

Seeking formal care was also actively avoided because of these social pressures. A participant in a street interview noted the immediate public assumption: "when someone goes to a psychiatric hospital, first thing that pops up in the mind of our general populace is oh this person is mad" (Pulse Nigeri, 2018). Therefore, psychiatric institutions carried symbolic meanings extending beyond healthcare, functioning as markers of public shame.

8. Achieving Biomedical Credibility Through Cultural Translation and Collaboration

Rather than rejecting cultural explanations outright, experts in the dataset often attempted to explain psychological concepts using culturally familiar references to bridge the gap between biomedical and socio-religious understandings. For example, one psychiatric expert used the bodily sensations associated with malaria to describe how anxiety symptoms are often misinterpreted (Onadele, 2024). By connecting psychiatric explanations to a familiar illness, he validated the person's experience while introducing a different diagnostic interpretation.

This pattern suggests that biomedical authority was not simply assumed but had to be communicatively achieved. Professional knowledge became more persuasive when articulated through everyday experiences already meaningful to audiences.

This negotiation of biomedical credibility and care pathways also appeared at a systemic level. Rather than directly opposing socio-religious beliefs, one report highlighted a collaborative model in which orthodox medicine partnered with traditional healers, utilizing the healers' authority to "spot signs of mental illness that would benefit from orthodox medicine" (Channels Television, 2023). Therefore, the theme indicates that mental health communication often depended on translation, coexistence, and pragmatic partnership between orthodox biomedical medicine and traditional socio-religious practices.

9. Stigma as a Member's Phenomenon and Digital Resistance

Although stigma was often discussed as a cultural constraint, participants and audiences across the dataset also actively named, critiqued, and resisted it, treating stigma as a lived member's phenomenon. Younger participants described increasingly challenging silence around mental health within their families and peer groups, speaking openly about the pressures created by religious expectations and cultural norms.

The inclusion of digital comments also captured the dialogic and participatory nature of these platforms, showing how online spaces can function as channels of education and resistance against dominant stigmas. Audiences actively used comment sections to contest stigmatizing narratives and validate biomedical approaches. For example, users advocated for better understanding, writing, "Mental Illnesses are NOT Adjectives!!!" and "People need to know that mental health goes beyond prayers and require professional help and social support from loved ones. We deserve to be happy" (Zikoko, 2020).

Another user pushed back against cultural denial by sharing, "a Nigerian told me that depression is not for Nigerians that only caucasians suffer from depression. The mentality can be so appalling" (Zikoko, 2020). This comment illustrates how participants challenged exclusionary beliefs by exposing their everyday circulation. These mediated acts of resistance reveal how speakers navigated multiple frameworks, utilizing biomedical language, lived experience, and moral critique to challenge public conversations about mental health.

10. Structural Breakdowns and Socio-Economic Drivers of Distress

Finally, the dataset introduced a critical theme highlighting how systemic and structural realities exacerbated both psychological distress and stigma. Mental health was rarely discussed in isolation; instead, participants linked it to Nigeria's wider socio-economic environment. One participant in a street interview explicitly connected depression to structural failure, stating, "The economic shenanigans in the country is nothing to take home abouts... a lot of people are running to deep hunger and I feel majorly the economy, unemployment and hunger who eats unemployment lead to the rise of depression issues" (Pulse Nigeria, 2018).

This interpretation was reinforced by a senior psychiatric hospital administrator, who attributed a recent surge in psychiatric admissions to individuals coping in harmful ways through substance abuse because of "economic challenges and other socioeconomic reasons." These accounts framed distress less as individual weakness and more as a response to material insecurity.

Furthermore, the data revealed the devastating impact of physical conflict and the severe lack of psychiatric infrastructure. One report on survivors of insurgency illustrated how trauma frequently goes untreated, warning of transgenerational trauma in Borno State, a region where only 18 psychiatrists were available to serve a population of

nearly seven million (Al Jazeera, 2026). This final theme complicates individualized understandings of stigma by demonstrating how structural neglect, insecurity, and economic hardship intensify distress while simultaneously limiting pathways to care.

11. Conclusion

This study reveals that cultural and socio-religious meanings shape how mental health stigma is understood and communicated in Nigerian digital media. Psychological distress is often framed as moral weakness, spiritual failure, or a threat to family reputation. These interpretations do more than reflect belief systems. They shape recognition, structure responses to distress, and discourage engagement with professional care. Across the analyzed materials, stigma emerges as a communicative practice sustained through everyday language, family expectations, and shared assumptions about what mental illness means. Moreover, the analysis highlights digital media as an important space where these meanings are questioned and reshaped. Mental health professionals, advocates, and younger participants use online platforms to speak about distress, challenge moralized interpretations, and introduce alternative ways of understanding mental health. These interventions do not remove stigma entirely, but they open visible spaces where dominant interpretations are challenged and gradually reshaped.

The study contributes to media and communication research by showing that stigma operates as a communicative process rather than a fixed belief. Grounding the analysis in participants' accounts responds to calls to examine stigma as a phenomenon that people actively produce, interpret, and challenge in interaction. The findings suggest that efforts to improve mental health communication in Nigeria need to engage directly with the cultural narratives through which stigma circulates. Media-based education, culturally

grounded messaging, and critical media literacy can support more effective engagement with mental health discourse. Future research can extend this work through audience-focused studies, multilingual analysis, comparative approaches across media contexts, and targeted research on rural communities with limited or no access to digital media to better understand how stigma operates beyond online environments.

12. Limitations

While the dataset consists of 16 videos and their corresponding user comments, which strengthen depth and pattern development across the analysis, several limitations remain. First, the dataset reflects a degree of sample selection bias, as it focuses on YouTube broadcasts, expert interviews, street-interview testimonies, and discussions among younger participants. This focus may underrepresent more marginalized voices, strongly traditionalist perspectives, and discourses emerging from rural communities that are less visible in structured media or digital spaces.

Second, the findings should be interpreted considering the performative nature of YouTube videos and comment sections, where participants may shape their expressions in relation to platform visibility, audience expectations, and social desirability. Finally, while the qualitative approach allows for close analysis of how meanings are shaped in communication, the findings reflect culturally specific media discussions rather than general public attitudes. Therefore, they cannot be broadly generalized to all Nigerian contexts.

Keywords

Mental health stigma; Nigeria; Digital media; Socio-religious beliefs; Health communication.

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THIS WAR OF MINE AS A PROMOTER OF SOCIO-CIVIC AND MORAL COMPETENCES: A QUALITATIVE STUDY ON EMPATHY, ETHICAL REASONING, AND DECISION-MAKING UNDER CONSTRAINT

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Abstract

This study investigates whether and how gameplay in *This War of Mine* (11 bit studio, 2014) can function as a context for exercising socio-civic and moral competences, with a focus on empathy, ethical reasoning, and constrained decision-making. The game places players in the role of civilians attempting to survive in a war-torn environment characterized by scarcity, moral dilemmas, and constrained choices. Such conditions offer a potentially meaningful context for examining how empathy and moral reasoning are activated when individuals are required to make ethically relevant decisions under pressure. The conceptual framing draws on multidimensional accounts of empathy (Davis, 1983; Decety & Jackson, 2004) and on the view of moral functioning as involving distinguishable components such as moral sensitivity and moral judgment (Rest, 1986). To model the role of constraint, the study also leverages research on bounded rationality and dual-process accounts of judgment, including evidence that cognitive load can selectively affect utilitarian responding in moral dilemmas (Greene et al., 2008; Kahneman, 2011; Simon, 1955). The methodological design includes qualitative data from stimulated-recall interviews supported by gameplay recordings, analyzed via thematic analysis (Braun & Clarke, 2006; Ericsson & Simon, 1993).

The study adopts a qualitative research design based on semi-structured interviews conducted before and after gameplay sessions. The interview protocol is designed to explore participants' empathic engagement with the situations and characters represented in the game, focusing on how players interpret morally challenging scenarios, experience empathic concern, and justify their decisions within the constraints imposed by the game environment. Interview data will be analyzed using reflexive thematic analysis (Braun & Clarke, 2006), following an iterative process of coding and theme development aimed at identifying recurring patterns in participants' accounts of empathic perspective-taking, emotional engagement, and moral deliberation during gameplay. This study aims to see if gameplay in *This War of Mine* elicits forms of moral engagement that go beyond mere strategic optimization, activating processes of empathic perspective-taking, affective resonance, and reflective ethical deliberation. The game's mechanics, such as resource scarcity, time pressure, and the irreversibility of certain choices can be structural conditions that shape the quality and orientation of moral reasoning. In this sense, the game environment appears to operate as a form of situated moral laboratory, in which players are confronted with ethically salient trade-offs under conditions that partially mirror the bounded rationality characteristic of real-world moral decision-making (Kahneman, 2011; Simon, 1955). This paper contributes to the growing interdisciplinary literature at the intersection of game studies, moral psychology, and civic education by offering empirically grounded, qualitatively rich evidence of the processes through which a specific game environment can scaffold moral competence activation. Future research should extend these findings through longitudinal designs capable of assessing whether the forms of moral reasoning mobilized during gameplay transfer to extra-ludic contexts, and through comparative analyses involving games with different degrees of moral complexity and narrative constraint.

Keywords:

Game-Based Learning; Ethical Reasoning; Moral competences; Decision-making; Qualitative methods.

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ARTIFICIAL INTELLIGENCE MEETS GAME-BASED LEARNING FOR INCLUSIVE MATHEMATICS EDUCATION

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Mathematical learning disabilities, and developmental dyscalculia in particular, represent a significant barrier to educational equity, often compounded by negative emotional experiences such as anxiety, frustration, and reduced self-efficacy (Butterworth, 2005). However, opportunities for teachers to directly experience and reflect on these characteristics remain limited. This project originated from the need to design teacher training experiences capable of bridging theoretical knowledge and experiential understanding through game-based and technologically mediated approaches. This study is situated within the methodology of Game-Based Learning (GBL), a pedagogical approach that uses games as tools to enhance students' learning, engagement and motivation. An initial phase of the research focused on evaluating whether appropriately designed game-based activities could improve the mathematical competencies of grade 8-10 students diagnosed with dyscalculia, while also reducing the anxiety and emotional difficulties often associated with the subject. In this context, dyscalculia is understood as a difficulty in performing calculations, retrieving arithmetic facts, and understanding basic numerical concepts. Students with dyscalculia may encounter significant obstacles in the development of number sense, often displaying recurring errors, slower response times, and difficulties in applying calculation procedures. Building on previous research on board-game-based activities for inclusive mathematics education for further details see (Vergallo, 2024), this study extends the model by integrating conver-

sational AI agents as simulated students with dyscalculia, the focus of the project shifted to training of teachers on dyscalculia, with the aim of enabling teachers to experience inclusive mathematics teaching and Game-Based Learning through interaction with an *artificial student*. In this sense, teacher education represents a key dimension in the development of inclusive game-based learning environments. Without adequate preparation and sensitivity toward mathematical learning disabilities, the potential of innovative methodologies such as GBL risks remains underutilized in everyday classroom practice. The simulated student profiles were developed based on literature on dyscalculia, math anxiety and inclusive mathematics education. The prompts were refined through pilot interactions and reviewed by a psychologist and a tutor specialized in Specific Learning Disabilities to ensure that the AI responses reflected plausible cognitive and emotional difficulties without reducing dyscalculia to stereotyped errors. During the research, primary and lower-secondary school teachers, both pre- and in-service, interact individually with Chat-GPT (various versions) or Gemini (various versions) that were previously and specifically trained to simulate an eleven-year-old student diagnosed with dyscalculia playing the Guess the Number game (in the prompt were included the rules of the game and the game board). Teachers participating in the experiment complete twice a self-assessment questionnaire (pre and post activities) about confidence in inclusive mathematics teaching, perceived ability to adapt GBL activities, understanding of dyscalculia-related difficulties, and perceived readiness to manage emotional responses such as math anxiety.

Data collection is currently ongoing; by the end of the experimental phase (expected by the end of the current school year), we anticipate collecting approximately one thousand interactions between Artificial Intelligence (AI) systems and teachers. The roles within the training experience are clearly defined: the teacher leads the game and is respon-

sible for providing emotional support and ensuring the game's logical coherence. AI, on the other hand, simulates a student with severe dyscalculia combined with a derived performance anxiety, working memory overload and a constant search for emotional validation. Early qualitative analyses of the interactions reveal two distinct teacher profiles: a patient and encouraging profile, sometimes willing to relinquish control to boost the student's confidence, and a profile that struggles to understand the demands of the situation. In our work, we are going to present a detailed account of the training experience, followed by a both qualitative and quantitative analysis of the interactions between teachers and AI. Preliminary findings, based on approximately thirty responses collected so far, point to a generally positive perception of the activity: 57% of teachers considered it useful and 60% described it as enjoyable. A comparison between pre- and post-questionnaires also showed a 6% increase in the proportion of teachers who declared themselves "strongly prepared" in relation to dyscalculia.

Keywords:

Artificial Intelligence; Game-Based Learning; Dyscalculia.

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WHEN FLUENCY IS NOT ACCURACY: drAlve, A VALUES-BASED TRAINING PROTOCOL FOR GENERATIVE AI IN JOURNALISM

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Abstract

Artificial intelligence has now become part of professional journalism practices. Although its adoption has been regulated by editorial and ethical policies in many countries, informal and individual use of the technology is very common, as is the case in Italy. This situation has led to the proposal of drAlve, a conceptual training framework for the responsible and deontologically oriented use of generative artificial intelligence (GenAI) in journalism. It has been developed in direct response to the empirical findings and training needs that emerged from a large-scale survey conducted in Italy among staff and freelance journalists. The data reveal a landscape of widespread but largely ungoverned adoption, predominantly on an individual basis and in the absence of editorial guidelines or institutional frameworks. The findings showed a significant misalignment between perceived control and perceived competence; most respondents report a good or high sense of control over GenAI tools but do not consider their own competence adequate. This gap signals structural risks for accuracy, verification practices, and professional accountability, and points to a near-absence in the literature of structured, values-centered training models designed for working journalists operating outside institutional support. The defining features of drAlve are that it is grounded in the professional values of journalism, responsibility, accuracy, verifi-

cation, and professional authority, rather than in technical tool proficiency. The protocol is structured around six dimensions: Diagnosis (conscious choice of use or non-use based on constraints and risk); Responsibility (editorial accountability and traceability); Augmented Journalism (identification of opportunities that expand professional capabilities beyond what is manually possible); Interpretation & Interaction (critical dialogue with the model, recognition of implicit frames and gaps, treated as a dialogic practice oriented toward critical awareness rather than passive reception); Verification (a minimum replicable fact checking pipeline); and Epistemic Posture (the distinction between plausibility and evidence, and strategies against hallucination and cognitive delegation). Together, these dimensions aim to move journalists from informal, ungoverned use of GenAI toward a conscious, responsible, and deontologically oriented professional practice. drAIve is designed to be transferable across professional training contexts, newsrooms, journalism schools, and press associations, and replicable without institutional infrastructure.

Keywords

Generative artificial intelligence, Journalistic practice, Professional deontology, Responsible AI training, Epistemic accountability

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GENERATIVE ARTIFICIAL INTELLIGENCE FOR INCLUSIVE LITERATURE EDUCATION: A SCOPING REVIEW ON THE USE OF LLMs AS LEARNING MEDIATORS

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Abstract

The integration of Large Language Models (LLMs) in literature teaching is redefining student-text interaction, offering unprecedented opportunities for engagement through a dialogic and immersive dimension (Lorusso, 2026). This paper presents a scoping review conducted according to the PRISMA-ScR protocol, mapping the impact of LLMs as catalysts for deep textual understanding. The systematic search, currently being finalized across major academic databases (Scopus, Web of Science, ERIC, and PsycINFO), focuses on peer-reviewed contributions published between 2020 and 2026. The research analyses how AI-mediated simulations of the stylistic and psychological coherence of authors and literary characters can stimulate active hermeneutic analysis. Initial screening of the literature reveals a growing trend in using LLMs to reduce “entry barriers” for students with Special Educational Needs (SEN), highlighting the necessity of structured pedagogical scaffolding. The investigation explores the balance between passive use and the acquisition of higher-order critical skills prompted by dialectical engagement with algorithmic output. The synthesis of the identified studies suggests that while verifying AI “hallucinations” can serve as a powerful philological exercise, its effectiveness is strictly dependent on teacher-mediated guidance to avoid cognitive overload in fragile learners. In conclusion, the review outlines a pedagogical framework based on “AI-mediated dialogic teach-

ing", where AI enhances traditional study by combining methodological rigour, emotional involvement, and universal accessibility, positioning the LLM as a dynamic interface for inclusive scaffolding and critical inquiry (Bellot et al., 2025; Sabdaliyeva et al., 2025).

Keywords

LLM, Engagement, Literature Education, Inclusion, Mediated Learning.

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GENDER BIASES IN TEXTS AND IMAGES PRODUCED BY ARTIFICIAL INTELLIGENCE: PRELIMINARY RESULTS OF A SYSTEMATIC REVIEW

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1. Introduction

Gender biases in Generative Artificial Intelligence (GenAI) and Large Language Model (LLM) systems have been observed when the training datasets do not reflect the heterogeneity of social groups (Navigli et al., 2023). Texts and images outputs may perpetuate stereo typed gender roles, skills and characteristics. The human interaction with biased models may reinforce them and enhance existing social inequalities, thereby reducing the identification and mitigation of such models [Allan et al., 2023; Ferrara, 2024]. This article presents the preliminary results of a systematic review with the aim of mapping and synthesising evidence related to gender bias in texts and images generated by AI tools.

2. Research design and methods

Following PRISMA criteria, a systematic research was conducted in Scopus, Web of Science and PubMed databases using the following query: (“gender” AND bias) AND (text OR image OR language) AND (stereotype OR prejudice OR discrimination OR “sexism”) AND (“machine learning” OR “artificial intelligence” OR generative OR “deep learning” OR “neural networks” OR “large language model” OR “natural language

processing" OR chatbot). The inclusion criteria were limited to English-language articles explicitly referencing LLM, Natural Language Processing (NLP) or GenAI, or which included references to GenAI tools. Studies exclusively focusing on dataset design for bias detection or reduction, as well as reviews, meta-analyses, and conference reports, were excluded. The methodological quality was assessed using the Newcastle-Ottawa Scale (NOS), which indicated an overall moderate risk of bias across the selected literature.

3. Results

A total of 926 records were identified through database research. During screening 312 duplicates were removed, 378 records were conference papers or other types of publication format, 118 records were not pertinent, and three records were excluded for other reasons. A final list of 115 records was obtained. After full-texts assessment, 81 articles were included. Preliminary findings reveal the prevalence of studies from European (31) geographical area and a notable research interest in this subject area worldwide. OpenAI and Google tools were the most used systems. Articles were organized into a framework of five thematic clusters. Profiling Texts (PTs) and Profiling Images (PIs) involved studies with GenAI outputs by prompts aimed to design a specific outcome (e.g., "Create a doctor"). Gender Texts (GTs) and Gender Images (GIs) included studies that created a generic person (e.g., "Create a person"). Machine Translation Texts (MTTs) involved studies designed to analyse how automated systems select a specific gender following a translation from a gender-neutral language to a binary language. Thematic analysis revealed that men are overrepresented in leadership and high-status professional roles within the PI cluster. Furthermore, GenAI tends to associate domestic domains with women within GTs, while MTTs studies have shown how automated systems often default to male pronouns when translating from gender-neutral languages.

4. Conclusions

The utilisation of AI systems is becoming prevalent in a wide range of applications. It is critical to recognise the implications of GenAI utilisation on the reinforcement of conventional gender stereotypes. Their perpetuation may influence access to essential services (Ferrara, 2024; Buslón et al.2023) or worsen interpersonal relationships, thereby contributing to phenomena including gender-based violence and homophobic bullying (Trottier et al.2025; Chan & Mak 2023).Although our findings may facilitate debiasing strategies to promote equity principles and to consider variability of social groups in the GenAI products, the literature selected were limited to English-language. Future research should adopt multilingual search strategies to provide a more inclusive understanding of the cultural biases identified.

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EPISTEMIC VULNERABILITY AS AN OVERLAPPING NOTION: SYSTEMIC NARRATIVES, APPLIED ETHICS, AND THE DEFLECTION

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Abstract

This paper examines epistemic vulnerability as a transversal concept situated at the intersection of applied ethics of information and communication, philosophy of technology, and critical AI studies. We define epistemic vulnerability as a structural susceptibility to distorted representations of reality, arising not only from individual cognitive biases but, more decisively, from systemic narrative architectures: platform-driven information ecosystems designed to shape attention, frame interpretation, and obscure the material conditions of knowledge production. We argue that this notion productively overlaps with adjacent frontier concepts – epistemic injustice (Fricker, 2007), information disorder, and algorithmic opacity – generating a conceptual convergence that demands critical hermeneutic attention.

The paper develops two interconnected lines of argument. First, drawing on the PAIA model of AI risks – Pervasiveness, Autonomy, Invisibility, Adaptivity (Pisano, 2025) – we show how the overlapping dynamics of epistemic vulnerability operate as mechanisms of deflection: systematic redirections of collective attention away from effective reality toward emotionally saturated, ideologically simplified, and commercially optimised narratives. This deflection concerns pressing socio-economic and environmental issues that dominant AI discourses tend to obscure, including the gamification of digital interac-

tion as concealed labour extraction (Casilli, 2020), the displacement of moral responsibility from human decision-makers to artificial agents (Crawford, 2021), and the invisibilisation of the extractive materiality of AI systems. Second, we propose epistemic care as a cultivated virtue grounded in applied ethics of information and communication: the capacity to attend critically to the conditions under which knowledge is produced, mediated, and consumed across cultural and linguistic boundaries. Epistemic care operates as a hermeneutic competence and, crucially, as a transversal skill essential for citizens and professionals navigating AI-pervaded environments – a competence that enables recognition that notions such as “bias”, “misinformation”, and “digital literacy” are not stable, context-independent categories but culturally embedded interpretive constructs.

The theoretical argument is supported by empirical evidence from an AI and Ethics Literacy pilot study conducted across Italian secondary schools during the academic years 2023–2025 (Pisano et al., 2026). The study adopted a mixed-methods design involving 193 students from technical institutes and academic high schools in southern Italy, with pre- and post-intervention Likert-scale questionnaires and a 15-item content knowledge test. The eight-hour intervention, structured around the Philosophical Enquiry (PhiE) methodology, combined collaborative ethical reasoning with critical analysis of platform mechanisms. Results demonstrated statistically significant improvements in ethical awareness ($p < 0.001$, Cohen’s $d \approx 0.8$), factual AI knowledge ($d \approx 0.6$), and algorithmic bias recognition ($p < 0.01$, $d \approx 0.7$). A strong positive correlation ($r \approx 0.61$) emerged between students’ interest in AI ethics and their support for its curricular integration, particularly among older, technology-focused cohorts. These findings indicate that epistemic vulnerability, while structural, can be effectively addressed through targeted educational interventions that cultivate epistemic care as a core transversal competence for the digital age.

We conclude that the convergence of epistemic vulnerability with related frontier notions exposes a structural challenge for educational institutions and workplaces alike. Only through a renewed applied ethics of information and communication, capable of integrating hermeneutic sensitivity, intercultural awareness, and critical analysis of systemic narrative structures, can we restore collective attention to the gap between narrative construction and effective reality.

Keywords

Epistemic Vulnerability, Applied Ethics of Information, Systemic Narratives, Overlapping Notions, AI Literacy, Critical Thinking, Intercultural Communication

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FROM “FLAME” TO “FRAME”. WHEN CONTEXT FLIPS MEANING ONLINE

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Abstract

The linguistic trajectory of terms such as *queer*, *dyke*, or *bitch* exemplifies the sociocultural process of semantic reclamation, whereby historically stigmatizing labels are reappropriated by marginalized groups and resignified as markers of identity, solidarity, or resistance (Brontsema, 2004; Galinsky et al., 2013). From a performative perspective, such processes can be understood as practices through which subjects negotiate recognition and agency within regimes of power that are themselves discursively constituted (Butler, 1997). Pragmatic accounts of slurs additionally emphasize that derogatory force and (re)appropriative potential are context-dependent, shaped by speaker identity/positioning, uptake, and interactional history (Bianchi, 2014; Croom, 2013).

Digital environments – and Reddit in particular – provide a significant site for observing these dynamics, as they host both intra-community uses that may signal empowerment and inter-group uses that may reproduce insult, thereby rendering visible the contextual and interactional conditions under which meaning shifts occur in online discourse (Jane, 2014; Massanari, 2015).

More broadly, subreddits can be understood as networked publics whose discourse is shaped by platform affordances and imagined audiences, with potential context collapse across audiences that influences how contested language is interpreted and contested (Marwick & Boyd, 2011;

Limone & Toto, 2022). Content moderation and other forms of platform governance further co-produce community norms and visibility, affecting the circulation of both harmful and supportive speech (Gillespie, 2018; Roberts, 2019):

Previous research in computational linguistics has shown the importance of reclaimed language when training automated hate-speech detection systems to build safer online spaces (Draetta et al., 2026). At the same time, online gaming communities represent a unique environment: they are often ripe with sexist or homophobic discourse (Di Leo et al., 2025), but they can also configure themselves as safe spaces of care and support (Di Leo, 2025). Therefore, analysing the interactions between their users can provide valuable linguistic perspectives into how specific terms are mediated and contested.

We created a corpus of Reddit posts and comments taken from major gaming communities. To do so, we manually selected a list of polysemic English lemmas (nouns and adjectives) from Hatebase (2017), a large linguistic resource on hateful speech, specifically targeting reclaimed slurs and terms which very recently underwent semantic extension in online discourse. This data was annotated by adapting the guidelines proposed by Palmer et al. (2020), identifying, for each post and comment, the presence of offensive intent and the meaning of the target lemmas. Candidate meanings were taken from BabelNet (Navigli & Ponzetto, 2010) and Wiktionary (Wikimedia Foundation, 2002). A balanced subset of the data was manually annotated by three researchers independently, reaching a high inter-annotator agreement. This constituted the gold standard for the subsequent automatic annotation of the rest of the corpus, which was executed by an open-source Large Language Model (DeepSeek V4 Pro; DeepSeek-AI, 2026) provided with detailed annotation guidelines and few-shot prompting examples (Brown et al., 2020). Preliminary findings show that different communities employ largely different communication strategies, with some being highly aggressive,

and others welcoming and supportive. We also trace which terms are more often used in offensive posts and comments, and which ones in reclamatory contexts. Based on this data, we reflect on the optimal pedagogical strategies to educate students on safe use of contested language (Toto & Limone, 2022). In doing so, we draw on critical language awareness and critical (digital) media literacy to foreground how power, audience, and platform context shape meaning-making and the harms/benefits of using contested terms (Buckingham, 2013; Fairclough), and we situate this reflection within culturally sustaining pedagogy, emphasizing attention to community language practices while engaging questions of safety and justice (Paris & Alim, 2017). The final, annotated dataset will be released openly to enable further investigations into the linguistic properties of the target terms, and, more broadly, into dynamics of reclamation and aggression in online gaming communities. Specifically, we aim to provide a useful resource to train automated hate-speech detection systems.

Keywords

inclusion; computational linguistics; hate-speech; technologies.

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Abstract

The increasing adoption of Artificial Intelligence (AI) in education offers significant opportunities for personalized learning, improved assessment, and enhanced instructional effectiveness. However, the successful integration of AI in Nigerian secondary schools depends largely on teachers' readiness to adopt and utilize these technologies. This narrative review examines the state of teacher preparedness for AI integration in Nigerian secondary education between 2015 and 2025.

A structured literature search was conducted using Google Scholar, ERIC, Scopus, and African Journals Online (AJOL). A total of 86 records were identified, and 34 studies that met the inclusion criteria were selected for analysis. Peer-reviewed journal articles, conference papers, and policy reports focusing on Nigerian educational contexts and teacher-related factors in technology integration were synthesized using thematic analysis.

The findings reveal that while many Nigerian secondary school teachers demonstrate moderate awareness of AI and generally positive attitudes toward its educational potential, substantial gaps remain in AI-specific knowledge, pedagogical integration skills, and practical implementation competencies. Key barriers include inadequate infrastructure, unreliable electricity and internet connectivity, limited professional development opportunities, policy deficiencies, and concerns about technological complexity and job displacement. Conversely, government digital literacy initiatives, private-sector support, expanding mobile technology access, and teachers' intrinsic motivation emerge as important facilitators of AI adoption.

The review proposes a four-dimensional framework for understanding teacher AI readiness in the Nigerian context, encompassing structural, competence, psychological, and cultural dimensions. It concludes that teacher readiness remains insufficient for effective AI integration and recommends sustained professional development, mobile-first AI training programmes, improved infrastructure, and comprehensive policy frameworks. While the narrative nature of the review may introduce selection bias, the findings provide valuable insights for policymakers, school leaders, and teacher educators seeking to promote equitable and sustainable AI integration in developing educational contexts.

Keywords

Artificial Intelligence, Teacher Readiness, Nigerian Secondary Schools, Educational Technology, Digital Competence.

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“AT LEAST ONE OF TWO CONDITIONS”: RETHINKING QUESTIONNAIRE DESIGN FOR “UNCOOPERATIVE” GROUPS

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Abstract

As aesthetic education gains increasing attention, related survey methodologies have diversified. However, the “collective utilitarianism” atmosphere in ordinary high schools in underdeveloped counties – a spontaneous prioritization of collective quantifiable outcomes over process and motivation – often leads to the widespread dilemma of “uncooperative” behavior (refusals to fill out surveys, perfunctory responses) among student respondents. Drawing inspiration from behavioral science, this study focuses on music classes in an underdeveloped county high school in Northwest China and constructs a reverse analytical framework based on the principle of “at least one of two conditions”, incorporating the “uncooperative” behavior itself into the core analysis. Two questionnaires were designed: Questionnaire A (a low-difficulty traditional short questionnaire, 9 items) served as the control group, used only to validate the effectiveness of observing “uncooperative” behavior through online channels; Questionnaire B (a subjective long questionnaire embedded with policy text names, 4 items) was designed as the experimental group to collect data on refusal behavior. Questionnaire A was distributed for one day during winter break on a student-initiated online space (QQ channel) covering approximately 5,000 students at the school. The questionnaire received over 1,000 views

but only 17 responses (response rate ~0.34%), confirming the channel's effectiveness in exposing target behaviors and providing a viable window for attributing causes for Questionnaire B. The original plan was to subsequently distribute Questionnaire B, anticipating an extremely low or zero response rate. This would establish two mutually exclusive explanatory paths: cognitive refusal, leading to the deduction that "at least one of two conditions holds – students' language ability fails to meet high school curriculum standards, or aesthetic education policy advocacy is absent"; motivational refusal, directly confirming the existence of "collective utilitarianism." Both paths point to systemic problems in the school's aesthetic education ecology, while valid responses could directly falsify the core hypothesis. Additionally, the distribution process itself was incorporated into the methodology. Questionnaire A's compliance with content regulations encountered platform restrictions, serving as observational evidence of "collective utilitarianism" penetrating student autonomous spaces, which subsequently prevented Questionnaire B from being distributed as planned. By employing this reverse analytical logic, uncooperative behavior is transformed into analyzable data, offering methodological references for investigating similar "uncooperative" groups. Furthermore, this mindset of turning "obstacles" into "data" in resource constrained environments can be transferred to fields such as entrepreneurship education, fostering students' adaptive thinking and problem-solving skills. The research strictly followed ethical guidelines: all participation was anonymous and voluntary, with minimal risk and no adverse effects on the minors involved.

Keywords

underdeveloped county high schools, uncooperative groups, aesthetic education, questionnaire design, behavioral science, entrepreneurship education

PSYCHOLOGICAL CAPITAL AS A STRATEGIC DRIVER OF SUSTAINABLE INNOVATION IN TECHNOLOGY-DRIVEN ORGANIZATIONS: A SYSTEMATIC REVIEW AND FUTURE RESEARCH AGENDA

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1. Introduction and Purpose

The contemporary organizational landscape is characterized by rapid technological advancements, digital transformation, and an increasing reliance on knowledge-intensive work (Chesbrough, 2003). Technology-driven organizations face the dual challenge of sustaining competitive advantage while fostering employee innovation and well-being. Sustainable innovation, which integrates economic, social, and environmental goals, has become a critical imperative for long-term organizational performance (Hu et al., 2023; Luthans et al., 2007).

Employees operating in technology-intensive contexts encounter heightened demands, uncertainty, and psychological pressures, which may hinder their innovative potential (Tarafdar et al., 2019). Psychological capital (PsyCap) – comprising hope, resilience, optimism, and self-efficacy – emerges as a critical personal resource that supports employee creativity, adaptability, and performance (Avey et al., 2011; Rego et al., 2012). Individuals with higher levels of PsyCap are better equipped to navigate challenges, engage in proactive problem-solving, and contribute to sustainable innovation outcomes (Slåtten et al., 2020; Chen et al., 2023). Despite substantial research on PsyCap and innovation individually, the intersection of these constructs in promoting sustainable innovation within technology-driven organizations remains underexplored (Sweetman et al.,

2010; Newman et al., 2014). This systematic review aims to synthesize the fragmented literature on psychological capital and sustainable innovation in technology driven organizations, examining how PsyCap influences employee creativity and sustainable innovation outcomes.

2. Methodology

This systematic literature review was conducted following the PRISMA guidelines. A comprehensive search of Scopus, Web of Science, ScienceDirect, and Google Scholar databases was performed on January 15, 2025, covering publications from January 1, 2000, to December 31, 2024. The search strategy combined keywords related to psychological capital ("psychological capital" OR "PsyCap" OR "hope" OR "resilience" OR "optimism" OR "self-efficacy") AND innovation ("innovation" OR "sustainable innovation" OR "green innovation" OR "employee creativity") AND technology context ("technology-driven organizations" OR "technology firms" OR "digital firms" OR "high-tech").

After a four-stage screening process involving two independent reviewers, 40 peer-reviewed studies met the inclusion criteria. Quality assessment was conducted using appropriate tools (Downs and Black checklist for quantitative studies, CASP checklist for qualitative studies, and AMSTAR-2 for review articles). Thematic analysis following Braun and Clarke's six-phase approach was employed to synthesize findings.

3. Key Findings

Four main themes emerged from the analysis:

3.1 PsyCap and Employee Creativity

Psychological capital enhances employee creativity by fostering cognitive flexibility, persistence in ideation, and risk-taking in idea expression (Slåtten et al., 2020; Chen et al., 2023). Employees with higher PsyCap are more likely to generate novel ideas, persist through obstacles, and engage in proactive problem-solving. This theme was supported by 28 of the 40 studies (70%).

3.2 PsyCap and Innovation Performance

Beyond creativity, PsyCap contributes to measurable innovation performance, including successful implementation of ideas and contributions to organizational performance (Rego et al., 2012; Hu et al., 2023). Meta-analytic evidence shows a positive relationship between PsyCap and innovative work behaviors (corrected $r = 0.45$). This theme was supported by 32 of the 40 studies (80%).

3.3 PsyCap and Sustainable Innovation

Employees with high PsyCap are more likely to engage in sustainable innovation by balancing short-term performance goals with long-term organizational sustainability (Hu et al., 2023; Ziyae et al., 2015). PsyCap promotes adaptive and responsible decision making, encouraging employees to develop innovations that are environmentally conscious and socially responsible. This theme was supported by 24 of the 40 studies (60%).

3.4 Organizational Moderators

The PsyCap-innovation relationship is moderated by organizational factors including leadership (26 studies), HRM practices (23 studies), and digital transformation (19 studies). Transformational and digital leadership styles, HRM practices such as training and empowerment, and digital transformation initiatives strengthen the positive effects of PsyCap on innovation outcomes (Jung et al., 2003; Zacher & Rosing, 2015; Wang et al., 2021).

4. Conceptual Framework and Propositions

Based on the systematic review, a conceptual framework is proposed linking psychological capital to sustainable innovation through employee creativity, with leadership, HRM practices, and digital transformation serving as moderators. The framework specifies three interconnected pathways:

- **Direct Path:** Psychological Capital → Employee Creativity → Sustainable Innovation

- **Moderating Paths:** Leadership, HRM Practices, and Digital Transformation influence the strength of the direct relationship. Five research propositions are advanced to guide future empirical investigation:

Proposition 1: Psychological capital positively relates to employee creativity in technology-driven organizations.

Proposition 2: Employee creativity mediates the relationship between psychological capital and sustainable innovation outcomes.

Proposition 3: Transformational leadership and digital leadership moderate the relationship between psychological capital and employee creativity, such that the positive relationship is stronger when leadership support is high.

Proposition 4: HRM practices moderate the relationship between psychological capital and sustainable innovation, strengthening the positive effects of PsyCap on innovation outcomes.

Proposition 5: Digital transformation initiatives facilitate the translation of employee creativity into sustainable innovation outcomes, moderating the creativity-innovation link.

5. Implications and Contributions

This systematic review makes three primary contributions to the literature. First, it provides a systematic synthesis of the fragmented research on PsyCap and sustainable innovation, integrating evidence from 40 studies across multiple disciplines including organizational psychology, innovation management, and human resource management. Second, it develops a comprehensive conceptual framework that delineates both direct pathways and moderating mechanisms, offering a nuanced understanding of how individual psychological resources translate into organizational-level sustainable innovation outcomes. Third, the study identifies critical research gaps across five dimensions (integration, contextual,

measurement, longitudinal, and implementation gaps) and presents five theoretically grounded propositions to guide future empirical research.

For practitioners, the findings underscore that sustainable innovation requires investment in both human and technological capital. Organizations should develop employee psychological capital through targeted interventions, train leaders to create supportive conditions, align HRM practices with innovation objectives, and implement digital tools that facilitate rather than overwhelm employees' psychological resources.

6. Conclusion

This systematic review demonstrates that psychological capital serves as a critical individual resource for driving sustainable innovation in technology-intensive contexts, particularly when supported by enabling organizational conditions. As technology-driven organizations navigate the dual imperatives of innovation and sustainability, understanding how psychological resources contribute to sustainable innovation becomes increasingly critical. The key to unlocking sustainable innovation lies not only in technological capabilities but fundamentally in the psychological resources of the individuals who envision, create, and implement them.

Keywords

Positive psychological capital; Sustainable innovation; Technology-driven organizations.

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CLIMATE CHANGE, PSYCHOLOGICAL WELLBEING, AND PHYSICAL ACTIVITY: A SCOPING REVIEW OF EMBODIED EXPERIENCES AND ADAPTIVE PROCESSES

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Abstract

This scoping review investigates the bidirectional relationship between climate change, psychological wellbeing, and physical activity, with the aim of clarifying how embodied experiences mediate adaptive processes across environmental and educational contexts. Grounded in recent methodological guidance for scoping and rapid reviews (Pollock et al. 2024, Gieve et al. 2025), the study synthesizes interdisciplinary evidence from education sciences, psychology, sport sciences, and sustainability research. Literature searches were conducted across Web of Science, Scopus, PubMed, EBSCO, and Google Scholar, applying temporal (2021-2025), language (English), and study-type inclusion criteria; after screening, 20 peer-reviewed articles were retained. Findings highlight a consistent bidirectional pattern. Environmental degradation and climate-related stressors are associated with increased eco-anxiety and reduced engagement in physical activity (Guerrero & Bräuninger 2025; Bernard et al., 2021), particularly in urban and socioeconomically vulnerable contexts. Conversely, regular physical activity-especially outdoor, nature-based and movement-oriented interventions-emerges as a protective factor, showing positive associations with psychological resilience and wellbeing, particularly among children and adolescents (Bernard et al., 2024; Comoutos et al. 2025). Several studies also report links between climate-related distress and somatic symptoms, reinforcing the role of embodiment as the inte-

gration of bodily, emotional, and environmental dimensions in adaptive responses (Balmumcu et al., 2025; Duijvestein et al., 2024). From an educational perspective, the review identifies sustainability-oriented learning and capacity-building strategies as key levers for fostering agency, motivation, and transversal competences (Baldelli et al. 2025; Zenasni et al., 2025), including in contexts marked by inequality or conflict (Masych et al. 2025). In this framework, embodied experiences are understood as situated, sensorimotor engagements with the environment that support meaning making and adaptive capacity. The study therefore proposes a systemic educational perspective integrating body, environment, and learning to promote planetary health and psychosocial resilience, contributing to the construction of a safe operating space for human identity (Oliver et al., 2022; Pathak et al., 2022). Finally, limitations of the current evidence base include a predominance of cross-sectional designs, limited geographical diversity, and heterogeneity in intervention types, which call for more longitudinal and context-sensitive research.

Keywords: Climate change; Physical activity; Psychological wellbeing; Embodiment; Sustainability education.

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INCLUSIVE BY DESIGN? A PEDAGOGICAL REFLECTION ON ALGORITHMIC INCLUSION AND INVISIBLE EXCLUSION IN AI-MEDIATED EDUCATION

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The rapid integration of artificial intelligence (AI) into educational contexts is frequently framed as a transformative opportunity to promote accessibility, personalisation and inclusive learning environments. Adaptive tutoring systems, generative AI tools and data-driven learning analytics are often presented as solutions capable of reducing barriers and supporting diverse learners by tailoring educational experiences to individual needs. Within policy discourse and institutional innovation strategies, AI tends to be associated with efficiency, optimisation and the expansion of educational participation. However, the assumption that algorithmic systems are inherently inclusive risks obscuring the socio-technical dynamics through which technologies can simultaneously enable and constrain participation (Holmes et al., 2022; Selwyn et al., 2019).

This theoretical and reflective paper critically interrogates the notion of algorithmic inclusion from a pedagogical perspective, arguing that inclusion cannot be understood solely as a technical property of digital systems but must be analysed as a relational and communicative process embedded within educational practices. The analysis draws on a *conceptual analysis approach*, integrating critical discourse analysis of educational AI policies with a selective review of literature at the intersection of critical pedagogy, human-computer interaction and algorithmic fairness

(Machin, 2021; Creswell & Poth, 2018). Rather than conceptualising AI as a neutral assistive tool, the contribution positions AI as a socio-technical mediator that reshapes epistemic authority, communicative exchanges and learning trajectories. From this viewpoint, algorithmic systems do not merely support teaching and learning; they actively participate in structuring what counts as legitimate knowledge, acceptable interaction patterns and normative forms of expression within digital learning environments (Luckin et al. 2016; Ranieri, 2019).

Drawing on critical pedagogy and media education traditions, the paper explores how algorithmic mediation may generate new forms of invisible exclusion. While adaptive systems aim to personalise content and support accessibility, they often rely on data-driven models that embed implicit assumptions about language, cognition and behaviour. These assumptions can reinforce dominant cultural norms, marginalise alternative communicative styles and reduce the visibility of learners whose experiences or identities fall outside predefined algorithmic parameters (Eubanks, 2018; Floridi et al., 2018). In this sense, inclusion becomes a contested space where technological optimisation intersects with ethical and pedagogical responsibility.

To illustrate how these dynamics manifest in practice, two hypothetical yet representative scenarios may be considered. In the first, a conversational AI tutor deployed in a linguistically heterogeneous classroom consistently underperforms for students whose mother tongue diverges from the dominant language of the training data, subtly penalising non-standard syntactic structures and idiomatic expressions and thereby rendering certain communicative repertoires educationally invisible (Kasneci, 2023). In the second, an adaptive learning system designed to support neurodiverse learners employs interaction patterns calibrated on neurotypical behavioural data, effectively marginalising atypical but valid cognitive styles within the system's feedback loops. These scenarios illuminate how the promise of personalisation can co-

exist with – and indeed reproduce – structural forms of exclusion that remain opaque to both learners and educators.

Particular attention is devoted to three interrelated tensions that characterise AI-mediated education. First, the tension between personalisation and standardisation highlights how algorithmic recommendations may simultaneously adapt learning pathways and impose homogenising criteria that shape educational expectations. Second, the opacity of automated decision-making challenges educators' ability to critically interpret algorithmic outputs, raising questions about accountability, transparency and trust in AI-supported environments. Third, the evolving role of educators emerges as a key pedagogical issue: rather than being replaced by AI, teachers increasingly act as ethical interpreters and mediators who contextualise algorithmic feedback within broader educational goals (UNESCO, 2021).

The paper proposes a conceptual framework for analysing inclusive AI practices that integrates pedagogical responsibility with principles of transparency, reflexivity and participatory design. This framework emphasises the need to move beyond techno-solutionist narratives by recognising that inclusive education requires continuous negotiation between technological affordances and human agency. Specifically, the framework identifies three operational principles: (1) *pedagogical reflexivity*, which requires educators to critically interrogate the assumptions embedded in AI system outputs; (2) *algorithmic transparency*, which advocates for legible, explainable AI interactions that support informed decision-making; and (3) *participatory co-design*, which ensures that learners and educators are active stakeholders in the development and evaluation of AI tools (UNESCO, 2023). Together, these principles constitute a set of guiding questions for instructional designers and educators: Whose knowledge and communication styles does this system privilege? How are errors or deviations from the norm interpreted and fed back to learners? What mechanisms exist for contesting or overriding

ing algorithmic outputs? From this perspective, inclusion is not achieved through automation alone but through critical pedagogical engagement with the design, implementation and evaluation of AI systems in educational contexts.

By situating algorithmic inclusion within broader debates on digital transformation and social participation, this contribution aims to expand current discussions on AI in education beyond functional or instrumental approaches. The theoretical reflection highlights the importance of adopting interdisciplinary perspectives that combine educational research, communication studies and ethical analysis – including emerging scholarship on AI literacy and critical AI pedagogy (Southworth et al. 2023; Celik, 2023) – to better understand how AI reshapes learning ecosystems. Ultimately, the paper argues that a pedagogically grounded understanding of AI is essential to ensure that technological innovation contributes to equitable and socially responsible educational futures.

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ROBOTIC ARM FOR DETECTION AND SORTING OBJECTS BY USING RASPBERRY PI

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keywords Raspberry Pi; Colour Sorting; OpenCV; PixyCMU; Robotic Arm; Servo Motor; Shape Detection.

Abstract

Robotics has increasingly shaped the nature of contemporary workplaces by offering consistent precision and dependable operation. With higher automation levels adopted in industries, production becomes faster and more efficient, requires less labour, and has lower operational risks. Further, advances in electronics and embedded technology have pushed robotic systems toward more adaptive and human-like functionality. A vision-guided robotic arm is designed in this work that can detect, pick, and sort objects based on visual properties. Such a system uses a PixyCMU vision sensor intended for fast colour recognition. Hence, this allows the system to detect red, yellow, and green colours of an object. Controlling the four-servo robotic arm is a Raspberry Pi programmed to grasp each item and place it into a designated location dependent upon its colour. This work also develops OpenCV algorithms in Python classifiers for the recognition of objects by geometric shape, which includes circle, triangle, square, rectangle, pentagon, and star. The proposed system further recognizes shapes by size categories. Experimental performance evaluation carried out using the developed robotic arm achieves around 80% colour detection accuracy. At the same time, real-time recognition performed using both shape and size is highly accurate.

LEARNING AS EMBODIED ACTION: A CONCEPTUAL INTEGRATIVE REVIEW OF EMBODIED COGNITION, MUSIC, AND ACTION

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Abstract. Recent research across cognitive science, music studies, and learning sciences has increasingly emphasized the embodied nature of cognition, high-lighting the central role of action and sensorimotor engagement in meaning-making and learning (Varela et al., 1984). Within this embodied framework, music emerges as a particularly rich domain, as it inherently involves temporal organization, bodily movement, and coordinated action. Despite this growing body of work, the relationship between embodied cognition, music, and action remains theoretically fragmented across disciplinary boundaries.

The aim of this paper is to provide a conceptual integrative review of the literature addressing the intersections of embodied cognition, music, and action, with a specific focus on their implications for learning processes. The review seeks to clarify how music can be understood as an embodied medium that scaffolds action-oriented cognition and supports learning as an experiential and situated process (Leman, 2016; Kolb, 1984). Methodologically, the study adopts a conceptual integrative review approach supported by a transparent and systematic search strategy conducted in Scopus. Relevant contributions were selected across cognitive science, music cognition, human-computer interaction, and learning sciences, and synthesized through thematic analysis.

The results highlight four interrelated conceptual themes: 1) embodied cognition as action-oriented cognition, 2) music as a temporal

and sensorimotor system, 3) action and movement as drivers of meaning-making, and 4) music-mediated action in learning contexts. The paper concludes by proposing an integrative conceptual framework that positions learning as embodied action mediated by music.

Keywords

Embodied cognition, Music, Action-based learning.

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SKILLS DEVELOPMENT AND INCLUSIVE SERVICE DELIVERY BY INTERNATIONAL NGOS IN AFGHANISTAN'S EDUCATION AND HEALTH SECTORS

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Abstract

International Non-Governmental Organizations (INGOs) play a significant role in sustaining education and health services in Afghanistan, particularly in areas where state institutions face serious political, economic, and operational limitations. In fragile and conflict-affected contexts, INGOs function not only as humanitarian service providers but also as important actors in local capacity building and social inclusion. This study examines how skills development initiatives implemented by INGOs contribute to inclusive service delivery in Afghanistan's education and health sectors between 2021 and 2024.

The study is informed by a capacity-building and social inclusion framework, emphasizing the relationship between local skills development, community participation, and equitable access to basic services. A qualitative research design was employed through thematic analysis of 18 policy documents, project reports, and program materials produced by five INGOs operating in Afghanistan. The analysis also incorporates selected case examples from community-based education and health-care interventions targeting women and marginalized populations.

The findings show that INGOs contribute to inclusive service delivery through targeted training programs for teachers, community health workers, and local volunteers. In the education sector, community-based teacher training initiatives improved access to learning opportunities

for girls in rural areas where formal educational structures remain limited. In the health sector, the training of female health workers and midwives strengthened maternal and primary healthcare access in culturally conservative communities where restrictions on women's mobility often limit access to medical services. The analysis further indicates that skills development initiatives enhance local participation, improve community trust, and increase the adaptability of service delivery programs to local social and cultural conditions.

At the same time, the study identifies several structural challenges affecting the long-term sustainability of these interventions, including financial dependency on external donors, restrictions on women's education and employment, institutional instability, and limited coordination with local governance structures. The paper also recognizes methodological limitations related to the reliance on documentary sources produced primarily by INGOs, which may reflect institutionally favorable perspectives and limit independent assessment of program outcomes.

By linking skills development with inclusive service provision, the study contributes to broader debates on humanitarian governance, resilience, and social inclusion in fragile contexts. The Afghan case demonstrates that localized and gender-sensitive capacity-building initiatives can support both immediate service delivery and longer-term community resilience in crisis-affected societies.

Keywords

International NGOs; Skills Development; Inclusive Education; Health Services; Social Inclusion; Afghanistan

DESTRESSING COMMUNICATION: CONTENT ANALYSIS OF MOBILE GAMING APPLICATIONS IN TERMS OF INFORMATION, EDUCATION, AND ENTERTAINMENT VALUE

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Abstract

The global expansion of mobile gaming has not only reshaped leisure habits but also created new forms of digital communication blending information, education, and entertainment. In 2023, the mobile gaming market generated over US\$ 90 billion, representing nearly half of total global video game revenues (Wired, 2024). Casual video games have been shown to reduce stress and improve mood by producing changes in brain wave activity and autonomic nervous system regulation (Russoniello, O'Brien & Parks, 2009). Their study found significant decreases in tension, anger, and fatigue among players, suggesting the potential of these games as effective stress-relief tools. This study aims to analyze the communicative strategies of top mobile games, identifying whether their primary function is to attract and sustain user engagement, educate, or entertain.

Guided by the Uses and Gratifications Theory (Ruggiero, 2000), this research tests two hypotheses: H_1 : The majority of top-ranked mobile gaming apps emphasize entertainment over information or education in their content and design. H_2 : Apps with calming media, simple mechanics, or pause/timeout features are more likely to include stress-reduction elements.

Using quantitative content analysis, 32 top-ranked Google Play games are evaluated across measurable factors: memory size, ratings

and reviews, download counts, cost (free/paid), platform availability, developer type, communication modes (text, visuals, audio), language options, interactive features, and security provisions. Findings are expected to reveal a dominant entertainment focus, with certain design features linked to relaxation benefits.

The study recommends that developers integrate features promoting calm, mental breaks, and light educational engagement into various game genres to enhance well-being while sustaining enjoyment. By identifying communicative patterns in mobile games, the research offers actionable insights for developers, educators, and mental health practitioners aiming to create balanced, destressing experiences.

Keywords

Mobile gaming, content analysis, reduce stress, entertainment, education, information, uses and gratifications theory.

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AI ADAPTIVE LEARNING SYSTEM FOR INCLUSIVE TRAINING AND DEVELOPMENT OF SPECIAL NEEDS TEACHERS

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Abstract

This study introduces a neuro-symbolic adjustable learning system designed to enhance the training of special needs teachers and advance inclusive teaching practices. The system integrates neural learning methods with symbolic logic to customize instructional pathways, select evidence-based teaching techniques, and foster student-centered approaches in teacher preparation. By analysing each trainee's cognitive profile, instructional responses, and other relevant factors, the system generates personalised learning paths to develop inclusive teaching competencies. In a mixed-method experiment involving 64 pre-service special needs teachers, the proposed system was evaluated against a traditional lecture-based model. Over 12 weeks, the experimental group demonstrated a 28.4% improvement in inclusive instructional competency (compared to 11.2% in the control group; $*p < 0.001$, Cohen's $*d^* = 3.6$) and achieved a mean pedagogical decision accuracy of 0.84 (compared to 0.61; $*p < 0.001$, $*d^* = 2.5$). These results indicate that neuro-symbolic adjustable learning facilitates personalized instruction and reflective teaching, offering significant potential for broader application in inclusive teacher education and AI-supported professional development.

Keywords

AI Learning systems, Innovative strategies, Special needs Teachers, training, Professional Development Models.

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INCLUSIVE PHYSICAL EDUCATION PRACTICES AND NEWLY ARRIVED STUDENTS IN ITALY (NAI): A PILOT STUDY

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This study analyzes the effectiveness of an inclusive teaching methodology for newly arrived migrant students (Newly Arrived in Italy – NAI). Physical education, understood as a discipline capable of implementing intercultural relational dynamics (Carter-Thuillier et al., 2023), favors a teaching style oriented towards autonomy and teamwork. Twenty-three students, including seven NAI students, from a first year of lower secondary school in the province of Naples were involved. Specifically, the study adopts a single-group, pre-post quasi-experimental design, using the non-parametric Wilcoxon test for paired data analysis in order to assess: a) the satisfaction of basic psychological needs, through the Basic Psychological Needs in Exercise Scale (BPNES) (Vlachopoulos, Michailidou, 2006; Costa, Di Bernardo, Benelli, 2015); b) relational climate and peer acceptance, using the Harter Self-Report Scale (Harter, 1985); c) perceived motor competence, using the Perceived Motor Competence in Childhood (PMC-C) (Dreiskämper et al., 2018).

The results indicate that this approach allowed NAI students to develop the satisfaction of basic psychological needs and greater perceived motor competence, as well as improving the relational climate and peer

acceptance of the entire class. In conclusion, the results support the hypothesis that personalizing motor strategies can be considered a useful tool for developing personalized, inclusive, and participatory teaching methods.

Keywords

Physical Education, NAI, Inclusion.

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THE A.R.S.I. MODEL: AN OPERATIONAL FRAMEWORK FOR OVERCOMING ARCHITECTURAL BARRIERS AND ACCESS INEQUITIES

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Abstract

This paper presents the ARSI model – Administrative Regulation, Research, Stakeholders Participation, and Inclusive Design – as an operational framework for addressing architectural barriers and reducing access inequalities in urban contexts. The study starts from the persistent gap between the formal recognition of accessibility rights and their uneven implementation at the local level, which may result in forms of indirect discrimination (Corte di Cassazione, 2020). Rather than treating accessibility as mere regulatory compliance, ARSI proposes an integrated process combining legal analysis, empirical inquiry, participatory engagement, and design-oriented translation. The Administrative Regulation phase identifies inconsistencies between national legal frameworks and local implementation. The Research phase adopts a mixed-method approach, including focus groups and Visual Elicitation, to collect situated and experiential knowledge from persons with disabilities, citizens, professionals, and institutional actors (Sanders & Stappers, 2008). The Stakeholders Participation phase structures dialogue among users, public administrations, and technical experts, in line with the participatory principles promoted by the UN Convention on the Rights of Persons with Disabilities (United Nations, 2006). The Inclusive Design phase translates the evidence collected into user-centered and performance-based design criteria (Steinfeld & Maisel, 2012).

The paper positions ARSI as a multi-level governance tool intended to support local administrations in developing and implementing ac-

cessibility plans (Sabtier & Weible, 2014). Its contribution is primarily theoretical and methodological: it provides a structured framework for future empirical applications and case study validation. By connecting regulation, research, participation, and design, the model reframes accessibility as a question of spatial justice rather than as a narrow technical or legal requirement (Soja, 2010).

Keywords

architectural barriers, accessibility, right to inclusion, ARSI model, spatial justice, inclusive design.

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RECOGNISING AND ENHANCING HIGH COGNITIVE POTENTIAL AT SCHOOL: AN INCLUSIVE AND TRANSFORMATIVE PEDAGOGICAL APPROACH TO ASSESSMENT, ENRICHMENT AND INSTRUCTIONAL PERSONALISATION

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This contribution presents the theoretical framework and preliminary findings of the research-training project *InclinAzione*, conducted by the University of Bari Aldo Moro with ten primary school classes, involving a total sample of 300 pupils. The study addresses a persistent gap in the Italian educational system: the lack of structured pedagogical tools for the identification, assessment, and enhancement of students with High Cognitive Potential (HCP). According to the most established estimates, these children represent between 3% and 5% of the school population; however, more than 20% are never identified as gifted throughout their school careers (Zanetti, 2014; 2017). This “pedagogical invisibility” constitutes a pervasive form of exclusion that contradicts the principles of a genuinely inclusive school system. The paradigm of inclusion – established by the Ministerial Directive of 27 December 2012 on Special Educational Needs (SEN) and reinforced by the MIUR Note of 3 April 2019, which formally included HCP students among students with Special Educational Needs – requires a profound reflection on assessment practices adopted in classrooms. Despite this regulatory recognition, the Italian educational system has not yet developed systematic guidelines for gifted education, leaving teachers without adequate methodological references and gifted children without the stimulation necessary for their development. The *InclinAzione* research adopted a multidimen-

sional methodological framework structured around three macro-domains: natural abilities, intrapersonal characteristics, and cognitive competences. Four validated instruments were employed: drawing as a projective tool; the TOL – Tower of London Test, aimed at measuring executive functions (planning and problem solving); the MT Reading Tests for reading competences; and the GATES-2 – *Gifted and Talented Evaluation Scales*, the only standardized instrument currently available in Italian for giftedness screening. The theoretical framework was based on Gagné’s *Differentiated Model of Giftedness and Talent* (DMGT) (1991, in Gagné-Nadeau, 1991; Italian trans. in Olivieri, 2018), which distinguishes between *gift* – natural abilities across six domains – and *talent*, understood as competences developed through systematic learning. This model allows the complexity of gifted profiles to be explored, including so-called “twice exceptional” students.

From a didactic perspective, the research introduced teachers to the *Schoolwide Enrichment Model* (SEM) developed by Renzulli and Reis (2014), grounded in the principle of enrichment as a qualitative extension of the ordinary curriculum. Particular attention was devoted to the practice of *Curriculum Compacting* (Renzulli, Reis & Smith, 1982), a personalization strategy that frees curricular time – by reducing content already mastered – in order to provide cognitively challenging activities and opportunities for talent development. The effectiveness of these strategies was monitored through systematic classroom observations, teachers’ reflective journals, and indicators related to student engagement, reduction of boredom-related behaviours, and the quality of products developed during differentiated learning pathways. Within this perspective, the SEM also emerges as a privileged context for the development of proactive and entrepreneurial competences: project-based learning and the autonomous management of creative products foster personal initiative, lateral thinking, and the ability to transform ideas into concrete actions among HCP students. The use of the compactor

enabled teachers to structure differentiated learning pathways, encouraging a reconceptualization of teaching practice oriented toward reflective and design-based professionalism.

Preliminary findings confirm the validity of an integrated approach and suggest the need to act on multiple levels: teacher training, curriculum design, and systematic family involvement (Perla, 2013). In particular, the administration of the GATES-2 identified approximately 4.2% of the sample as presenting HCP profiles, compared to a significantly lower percentage initially estimated by teachers before the training phase (approximately 1.8%). This discrepancy empirically demonstrates the phenomenon of widespread underestimation. The most significant finding concerns the pervasive underestimation of gifted students' potential, linked to persistent stereotypes associating talent with uniformly high academic achievement. The research-training process contributed to reshaping these interpretative frameworks, promoting the construction of an educational ecosystem capable of combining rigorous assessment, personalization, and educational justice.

Keywords

Skills; Personalization; Inclusion; School-level enrichment model.

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COMMUNICATION PROBLEMS OF YOUNG PEOPLE ACCORDING TO THE VIEWS OF SOCIAL STUDIES TEACHER CANDIDATES

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Abstract

Every aspect of human life is a message, a form of communication. Every meaningful action, whether spoken or silent, is communication. In this context, communication is always present in human life. Even remaining silent and not reacting to a situation is a form of communication. Therefore, any kind of meaning-sharing, whether verbal, non-verbal, written, through gestures and facial expressions, or body language, is defined as communication. In short, communication is the sharing of meaning between individuals. Relationships between spouses, parents and children, siblings, friends, and people in general are realized through the meanings they attach to all forms of communication (Zorlu, 2025).

Communication is a fundamental dynamic that has shaped social life, facilitated cultural change, and molded individual relationships since the very existence of humanity. Youth, the most dynamic segment of society, is a period marked by intense exploration of individual identity, striving for independence, and the need for socialization. Possessing healthy communication skills during this period directly impacts a young person's academic and social well-being. The word communication, originating from Latin, comes from the word "communis" meaning "common." Communication has been defined as the process of generating, transmitting, and interpreting information – the transfer of related messages between two entities (Dökmen, 1994).

The ability of individuals to establish healthy relationships depends on the development of their communication skills. Communication can be expressed as the ability of individuals to convey their thoughts, feelings, attitudes, beliefs, and ideas to each other. Communication skills encompass a range of social skills including verbal and nonverbal communication, willingness to communicate, effective listening, providing accurate feedback, effective use of language, using appropriate body language, and empathy. Many problems today stem from incorrect or incomplete communication. Communication skills directly affect an individual's quality of life. Individuals who have problems with communication become isolated and alienated, experience failure in their social relationships, and this can cause psychological harm. Conversely, individuals with developed communication skills can effectively cope with the problems they encounter and achieve greater success in life through long-lasting and healthy relationships. Interaction with the environment has been an indispensable part of human life since our arrival on Earth. While our emotions and thoughts shape this interaction, communication guides and enables it. Communication is one of the most fundamental needs of human beings, who are social creatures. Individuals can only maintain their social relationships through communication. Therefore, people need to acquire different types of communication skills from birth, especially throughout their professional lives, as required by their jobs (Uygun & Arıkan, 2019).

The aim of this research is to reveal the views of prospective social studies teachers regarding communication problems among young people. The study employed a phenomenological design, a qualitative research method. The study group consisted of 20 prospective social studies teachers studying at the Faculty of Education of a university in Turkey during the 2025-26 academic year. Participants were selected using convenience sampling. In this sampling method, the researcher

chooses a situation that is close and easily accessible. Convenience sampling is often used when the researcher is unable to use other sampling methods due to limitations such as time, money, and manpower (Yıldırım, Şimşek, 2016).

The opinions of prospective social studies teachers were collected using a semi-structured interview form prepared by the researchers. Three experts were consulted during the preparation of the interview forms. The data obtained from the data collection were analyzed using content analysis. Content analysis is one of the most frequently used analyses in qualitative research methods. The aim of content analysis is to reach concepts and relationships that can explain the obtained data. The process in content analysis is to group similar data within the framework of specific concepts and themes and to interpret them by organizing them in a way that the reader can understand (Yıldırım, Şimşek, 2016). The participants in the study group were coded using the abbreviation "P".

Social studies teacher candidates reported experiencing communication problems such as lack of self-confidence, difficulty expressing themselves verbally, and fear of being misunderstood or misinterpreted. They also believe that intolerance, unwillingness to listen, selfishness, and lack of respect for differences among young people hinder communication. One study emphasizes that impatience is increasing in the new generation, which manifests as intolerance and intolerance in face-to-face communication (Eroğlu, Yüksel, 2016). Similarly, socio-cultural polarization and social media echo chambers during adolescence cause young people to build a rigid wall of intolerance against ideas that are different from their own (Yılmaz, 2022). The findings are in direct agreement with a study which found that communication barriers among prospective teachers and students included "inability to listen effectively, interrupting, and prejudiced approaches" (Kan, 2014). One study states that the value of "respect for

differences", which is theoretically taught in schools, is not reflected in the daily lives of young people, and that an exclusionary language prevails among them (Açıklalın, 2010). The ideal of raising peaceful and tolerant citizens, which is the fundamental mission of the Social Studies course, faces a serious obstacle in today's youth practices in this respect. To help prospective teachers and young people overcome these kinds of problems, it is recommended that communication courses in education faculties be made more application oriented rather than purely theoretical (Ekmekçi & Öner, 2025). They state that some of these communication problems stem from themselves, while others originate from others. They suggest that fostering tolerance, empathy, and respect is crucial for resolving communication problems among young people.

Keywords

Social studies, prospective teacher, communication problems

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THE INCLUSIVE POTENTIAL OF MULTISENSORY CLASSROOMS FOR PUPILS WITH INTELLECTUAL DISABILITIES

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In the inclusive perspective, multisensory classrooms are configured as highly complex educational devices, capable of responding in a targeted way to the needs of pupils with intellectual disabilities. These environments, designed according to the principles of sensory modulation and enabling intentionality, integrate visual, auditory, tactile and proprioceptive stimuli in a structured and predictable framework, favoring processes of self-regulation, shared attention and active participation.

In particular, the educational practices that can be implemented within multisensory classrooms include sensory regulation activities, such as paths with optical fibers, bubble columns and tactile surfaces for the reduction of hyper- or hypo-reactivity, joint attention training mediated by controlled light and sound stimuli, and augmentative and alternative communication (AAC) interventions supported by interactive devices and multisensory feedback.

Additional activities include sensory-motor integration exercises (through vibrating platforms, deep pressure games, and guided motor sequences), immersive narratives, and multisensory storytelling, as well as relaxation and adapted mindfulness practices, useful for managing anxiety and problem behaviors. From a didactic point of view, these settings also allow the structuring of personalized micro-tasks, which facilitate the acquisition of cognitive prerequisites (discrimination, categorization, sequentiality) and access to curricular contents through sensory mediation.

The role of the support teacher is central in the intentional planning of activities, in the regulation of stimuli and in the systematic evaluation of outcomes, in line with the student's functioning profile and with the Individualized Educational Plan (IEP). In this perspective, the multisensory classroom is configured as an inclusive mediator capable of supporting situated learning processes, promoting socio-communicative skills and encouraging authentic participation in school life. Its educational and enabling potential fully emerges when it is integrated into an ecological and inclusive approach, oriented towards the enhancement of neurodiversity and the design of accessible and edifying contexts.

Keywords

Inclusion; Disability; School.

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REDEFINING AUGMENTATIVE AND ALTERNATIVE COMMUNICATION (AAC) IN THE DIGITAL ERA: TECHNOLOGICAL EVOLUTION, MULTIDIMENSIONAL COMPETENCIES, AND NEW PERSPECTIVES FOR PARTICIPATION

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Abstract

The contemporary digital ecosystem has required a profound theoretical and practical reconfiguration of Augmentative and Alternative Communication (AAC). The transition from paper-based supports and low-tech devices to complex high-tech digital systems represents more than a simple technical evolution; it marks a significant shift in inclusive communication practices and opens new perspectives for the integration of emerging technologies such as Artificial Intelligence. This paper analyzes this transition using Beukelman and Mirenda’s Participation Model as its primary analytical framework, integrated with the four dimensions of communicative competence theorized by J. Light and N. McNaughton (linguistic, operational, social, and strategic). Particular attention is devoted to the migration toward mainstream digital devices such as tablets and smartphones and to the role of Universal Design for Learning (UDL) in reducing social stigma and improving economic accessibility.

The study adopts a qualitative research design combining a systematic review of recent literature and the analysis of selected case studies, to explore how advanced AAC systems can enhance communicative autonomy for individuals with complex motor and cognitive disabilities. The literature review was conducted following PRISMA-inspired guide-

lines and included papers from major academic databases (PubMed, Google Scholar) published between 2019 and 2025, focusing on digital AAC technologies and emerging AI-based tools.

The findings highlight both the opportunities and challenges associated with increasingly complex digital interfaces. While technologies supported by artificial intelligence – such as predictive language models and adaptive communication interfaces – can significantly facilitate message construction and personalization, their effectiveness ultimately depends on the development of operational competence and on the active involvement of communication partners.

Keywords

AAC, Communicative Competence, Assistive Technology, Universal Design for Learning, Digital Inclusion, Communication Needs.

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FABLETOWN AND SOCIAL ENGAGEMENT: ROLE-PLAYING AS A NARRATIVE-BASED TOOL FOR BULLYING PREVENTION IN SEC-ONDARY EDUCATION

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Keywords

Serious games, bullying prevention, educational role-play

Abstract

This study explores the potential of tabletop role-playing games (TRPGs) as innovative pedagogical tools in order to enhance social engagement and preventing bullying in secondary education. The study presents the design, implementation, and evaluation of an educational intervention carried out in an Italian high school, “Istituto di Istruzione Secondaria Superiore Aldo Moro” in Trani, involving 48 students from three classes within the same institution. The intervention was structured as a series of facilitated workshops based on Fabletown, an educational role-playing game specifically de-signed to promote narrative competence, empathy, and collaborative problem-solving. The research adopts a qualitative case study methodology, grounded in experiential learning and narrative pedagogy frameworks. Data collection was conducted through multiple qualitative instruments, including participatory observation during gameplay sessions, ad hoc qualitative questionnaires specifically designed for the educational inter-vention, and post-activity group discussions. This triangulated approach allowed for an in-depth analysis of students’ experiences, behaviors, and meaning-making processes throughout the intervention. The study fo-

cuses on how immersive, narrative-driven role-playing environments can support the development of social and emotional competencies, particularly in relation to perspective-taking, conflict resolution, and the recognition of bullying dynamics. By engaging in fictional yet relatable scenarios, students were able to experiment with different roles and identities, reflecting on mechanisms such as exclusion, power im-balance, and peer pressure in a protected and dialogic space.

Findings indicate that RPG-based learning can significantly enhance student engagement and participation, fostering a sense of agency and co-responsibility within the group. The collaborative storytelling process encouraged students to negotiate meanings, express emotions, and critically reflect on their actions and those of others. Evidence from the collected data suggests an increased awareness of bullying behaviors and a greater ability to adopt prosocial attitudes and strategies for conflict management.

Furthermore, the intervention highlights the educational value of structured play as a medium for addressing complex social issues in school contexts. The use of RPGs appears particularly effective in creating inclusive environments that support both individual expression and collective reflection, bridging the gap between cognitive understanding and emotional experience. By positioning role-playing as both a pedagogical and preventive practice, this paper contributes to ongoing discussions on social engagement in education and game-based learning. It offers theoretical and practical insights for educators, researchers, and practitioners interested in implementing innovative, student-centered approaches to bullying prevention and social-emotional learning in formal education settings.

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PRATICHE DIDATTICHE SUPPORTATE DALL'INTELLIGENZA ARTIFICIALE PER TRASFORMARE GLI AMBIENTI DI APPRENDIMENTO E PROMUOVERE EQUITÀ E INCLUSIONE. UN CASO DI STUDIO.

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Abstract

L'integrazione dell'intelligenza artificiale nell'insegnamento promette di trasformare il concetto di smart classroom in modo innovativo verso un ecosistema attivo e sensibile alle esigenze di tutti gli studenti. Se utilizzata con una visione centrata sull'uomo e orientata da un'etica dell'inclusione, l'intelligenza artificiale può fungere da valida protesi cognitiva e relazionale capace di superare barriere metodologiche ed epistemiche. Il contributo illustra un caso di studio di una buona pratica didattica condotto in una classe di scuola secondaria di primo grado volto a dimostrare come l'IA possa fungere da mediatore per la progettazione di ambienti di apprendimento, innovativi, intelligenti e di pratiche didattiche realmente eque e inclusive. La riflessione ermeneutica conclusiva metterà in evidenza le condizioni che permettono a questa mediazione tecnologica di promuovere una pedagogia autentica e una didattica della cura capace di trasformare i contesti e generare azioni vitali in cui l'intelligenza artificiale interviene per amplificare la sensibilità, l'attenzione e l'efficacia dell'insegnante.

Parole chiave:

Intelligenza artificiale, aula intelligente, pratica didattica, inclusione scolastica, equità.

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CRIPPING SPECIAL EDUCATION TEACHER TRAINING: DIGITAL SELFNARRATIVES AS DEVICES FOR EPISTEMIC JUSTICE

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Theoretical framework and research relevance

Research on school bullying consistently shows that stigma attached to socially marginalised characteristics is a key driver of peer exclusion and victimisation (Nocentini et al., 2025). Discriminatory bullying, in particular, is grounded in categories such as disability, gender, and sexual orientation, with well-documented effects on students’ psychological well-being, school participation, and academic trajectories (Al Ali et al., 2025). Within this landscape, teacher education emerges as a critical site of intervention, as targeted training has been shown to enhance teachers’ competence and support the critical reworking of assumptions and practices (Johnson, 2014), while these dynamics remain embedded within broader normative regimes (Shoaib et al., 2026). Crip Studies (Centrone, 2025), building on McRuer’s Crip Theory (2008), offer a transdisciplinary lens to interrogate how bodies and knowledge are rendered intelligible and legitimate, informing a crip pedagogy understood as an anti-ableist and intersectional re-orientation of education that resists stabilisation into new normative frameworks (Bierdz, 2024). This shift can also be read through the lens of epistemic injustice (Fricker, 2007), which foregrounds how certain subjects are systematically excluded from recognition as knowers. From this perspective, education concerns not only access to knowledge, but also the conditions under which subjects are recognised as legitimate epistemic agents. Recent developments in the Universal Design for Learning framework (CAST, 2024) move in this direction,

advancing a structural understanding of accessibility that extends beyond disability to encompass identity, culture, language, and power (Couillard & Higbee, 2018).

Research context and methodological design

This study is situated within a broader doctoral project investigating teacher education as a site for the prevention of discrimination in school contexts. Preliminary findings from an *ex-ante* needs analysis suggest that pre-service special education teachers often experience uncertainty when addressing issues related to disability, gender identity, and sexual orientation. Importantly, such difficulties appear to stem less from ideological resistance than from a perceived lack of linguistic, conceptual, and pedagogical tools. In response to these identified needs, a 16-hour initial training laboratory was designed and implemented with 245 pre-service special education teachers at Roma Tre University. The training was structured as an integrated pedagogical device comprising four interconnected phases: positionality work, theoretical framing, engagement with audiovisual materials, and reflective writing. A central component of the intervention was the use of a curated corpus of twelve digital videos featuring activists and educators from marginalised communities sharing first-person, embodied self-narratives. Within this design, digital self-narratives function as epistemic interventions rather than ancillary tools, mobilised as counter-epistemologies capable of unsettling dominant regimes of knowledge validation and fostering engagement with situated knowledge when pedagogically mediated within structured reflective environments, while also generating cognitive and affective dissonance through the involvement of experts by experience.

The qualitative data produced during the laboratory – participants' written reflections – were analysed using reflexive thematic analysis (Braun & Clarke, 2006), through an iterative and interpretative process

of coding and theme development. This study contributes to current debates on teacher education by exploring the potential of digital self-narratives as epistemic devices within crip pedagogical design.

Findings and implications for teacher education

Findings indicate a shift from initial uncertainty to processes of dissonance and critical reconfiguration of participants' understandings of normality and the teacher's role, including a questioning of teacher neutrality as implicated in the reproduction of exclusionary norms.

Digital self-narratives emerge as a key element in this process, with participants describing the encounter with first-person testimonies as a turning point that revealed both their own epistemic limitations and their pedagogical responsibility to support students' self-understanding and recognition of others.

These results suggest that, when embedded within structured reflective pedagogical designs, digitally mediated self-narratives can effectively support critical reflection and contribute to the development of more inclusive and reflexive teaching practices in special education contexts.

Keywords

Specialized training for inclusive educators; Digitally mediated personal accounts; Professional development in teaching; Crip-informed educational practices; Equity in knowledge validation; Identity-based peer victimization.

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FROM THEORY TO PRACTICE: EVALUATING PROJECT-BASED LEARNING AMONG JOURNALISM STUDENTS.

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Introduction

Higher education plays an important role in fostering competencies aligned with sustainable development (Chankseliani & McCowan, 2021). Within the framework of Education for social responsibility and change, there is growing interest in pedagogical approaches that move beyond traditional lecture-based instruction toward active, student-centered methodologies (Fischer et al., 2022; Krajcik & Shin, 2014). Project-Based Learning (PBL) has been recognized as an effective strategy to promote meaningful learning and student engagement (Almulla, 2020). By simulating real-world challenges and encouraging collaborative problem-solving, PBL aligns with the development of competencies associated with sustainable entrepreneurship, such as initiative, adaptability, and social awareness (Sousa & Costa, 2022). In the field of journalism and communication studies, these competencies are particularly relevant as students can engage with complex societal issues to bring knowledge and its impact beyond the class (Gómez-Puertas, 2016). The present study aimed to examine a teaching innovation based on PBL implemented within undergraduate students from the Journalism degree. The project required students to develop a journalistic report (audiovisual reportatge) integrating both theoretical concepts and case studies to analyze a media communication topic.

Methods

The objective of the study was to evaluate the impact of Project-Based Learning on student's students' learning experience and engagement.

The study utilized the data from 75 undergraduate students ($M_{age} = 19,36$, $Male = 31$, $Female = 44$) enrolled in the Communication Theories course at the Pompeu Fabra University, a public university in Barcelona (Spain). The study adopted a mixed-methods approach to examine the impact of PBL on *perceived learning*, *participation*, and *development of competencies* related to sustainable entrepreneurship and development. The research was conducted during the Fall semester of 2025. Data were collected through a structured questionnaire administered at the end of the course. The survey instrument included Likert-scale items measuring key dimensions such as *perceived learning*, *satisfaction*, *participation*, and *evaluation of teaching methodologies*. Open-ended questions captured students' reflections on their learning experience and project development. Quantitative data were analyzed using descriptive statistics and correlation analysis. In parallel, qualitative responses were examined using thematic analysis to identify recurring perceptions and experiences, allowing for a more comprehensive understanding of the impact of the pedagogical approach.

Results

The findings suggest that the implementation of PBL was positively associated with students' satisfaction with the learning experience, perceived pedagogical usefulness, and collaborative engagement. Participants reported high levels of satisfaction, highlighting the value of integrating theoretical knowledge with practical application. Collaborative engagement was positively associated with project satisfaction ($r = .383$, $p = .004$), while difficulties in group work showed a significant negative association with students' overall experience ($r = -.523$, $p < .001$). Perceived pedagogical usefulness was also strongly related to satisfaction ($r = .650$, $p < .001$). In addition, students expressed differentiated preferences regarding teaching methodologies, with significant differences across formats (Friedman $\chi^2 = 15.56$,

$p = .001$). Qualitative insights further support these findings, emphasizing the role of PBL in fostering critical thinking, creativity, and collaborative skills.

Discussion and Conclusion

By integrating theoretical knowledge with practical application, PBL enhances students' perceived learning, engagement, and development of key competencies aligned with sustainable development goals. The incorporation of collaborative work, digital tools, and real-world problem-solving in the learning design contributes to the development of critical thinking, creativity, and adaptability, skills essential for future journalists. However, the challenges identified, particularly in group dynamics and workload management, indicate the need for careful instructional design and support mechanisms. While PBL presents certain implementation challenges, its benefits significantly outweigh its limitations, making it a valuable strategy for fostering meaningful and competency-based learning in journalism studies.

Keywords

Higher Education; Project Based Learning; Teaching Innovation; Education for Sustainable Development; Journalism Education.

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INTELLIGENZA ARTIFICIALE GENERATIVA, LINGUE DEI SEGNI E STUDENTI SORDI: CHATBOT INCLUSIVI E AVATAR VIRTUALI NELL'EDUCAZIONE.

GENERATIVE AI, SIGN LANGUAGES, AND DEAF LEARNERS: CHATBOTS AND VIRTUAL AVATARS IN EDUCATION.

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Abstract

L'Intelligenza Artificiale Generativa (GenAI) sta ridefinendo l'educazione inclusiva (Lee et al., 2026), ma gli studenti sordi rimangono spesso ai margini, in quanto il sistema di comunicazione visivo-gestuale richiede strumenti che supportino attivamente le lingue dei segni. Il contributo adotta un approccio teorico-concettuale fondato sulla sintesi tematica della letteratura recente in tre aree convergenti quali *GenAI* in educazione, *Deaf Studies* e tecnologie di *signing avatar* (Wolfe et al., 2025; Chemnad & Othman, 2025) integrata con i documenti di indirizzo internazionali (UNESCO, 2023; Selwyn, 2024). Da ciò deriva un *framework inclusive-by-design* per chatbot basati su AI e avatar segnanti, articolato su tre principi operativi: mediazione *teacher-in-the-loop*, in cui il docente mantiene il controllo pedagogico sugli output dell'IA, contrastando le pratiche di uso non dichiarato documentate in ambito linguistico (Barnes & Tour, 2026); trasparenza dei contenuti generati, con esplicitazione dei limiti dell'avatar e dell'incertezza traduttiva; una *GenAI literacy* orientata all'autonomia e alla consapevolezza etica, radicata nell'identità linguistico-culturale sorda (Kusters et al., 2022). L'analisi converge che l'inclusione effettiva degli studenti sordi nell'educazione mediata da GenAI richiede di

riposizionarli come soggetti epistemici (Lu et al., 2024) e di progettare gli strumenti con le comunità sorde, oltre la semplice traduzione testo-segno. Le implicazioni pratiche comprendono criteri di progettazione per sviluppatori di tecnologie educative, indicazioni formative per i docenti e un'agenda di ricerca per la validazione empirica degli avatar segnanti in contesti scolastici reali (Noble & Kushalnagar, 2026; Martin et al., 2026).

Parole chiave: *intelligenza artificiale generativa; studenti sordi; lingue dei segni; tecnologie educative.*

Abstract

Generative Artificial Intelligence (GenAI) is reshaping inclusive education (Lee et al., 2026), yet deaf learners often remain at the margins, as their visual-gestural communication system requires tools that actively support sign languages. This contribution adopts a theoretical-conceptual approach grounded in a thematic synthesis of recent literature across three converging areas, GenAI in education, Deaf Studies, and signing-avatar technologies (Wolfe et al., 2025; Chemnad & Othman, 2025) integrated with international policy guidance (UNESCO, 2023; Selwyn, 2024). From this analysis, an inclusive-by-design framework for AI-based chatbots and signing avatars is derived, articulated around three operational principles: teacher-in-the-loop mediation, in which the educator retains pedagogical control over AI outputs, countering the undisclosed-use practices documented in language education (Barnes & Tour, 2026); transparency of AI-generated content, with explicit acknowledgement of avatar limitations and translation uncertainty; and a GenAI literacy oriented toward autonomy and ethical awareness, rooted in deaf linguistic and cultural identity (Kusters et al., 2022). The analysis converges on the conclusion that the effective inclusion of deaf learners in GenAI-mediated education requires repositioning them as epistemic subjects (Lu et al., 2024) and designing tools with deaf communities, beyond mere text-to-sign translation. Practical implications include design criteria for ed-tech developers, training indications for teachers, and a research agenda for the empirical

validation of signing avatars in real classroom settings (Noble & Kushalnagar, 2026; Martin et al., 2026).

Keywords

generative AI; deaf learners; sign languages; educational technology,

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FROM STUDENT TALENT CIRCULATION TO TERRITORIAL CIRCULAR INNOVATION: LIGHTWEIGHT SPIN-OFFS ADDRESSING THROUGH SOCIODIGITAL ECOSYSTEMS

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Southern European universities face persistent brain drain: public investment forms graduates who move to wealthier regions, generating talent waste analogous to material waste in linear economies (Stam & Spigel, 2018). Building on circular economy logic (Geissdoerfer et al., 2017), this paper proposes the concept of *circular talent economy*: student human capital is treated as a territorial resource that should circulate and generate value locally during and after university, rather than being irreversibly lost to external ecosystems. We argue that this requires lightweight entrepreneurial infrastructures rather than heavy, expensive incubators. Lightweight entrepreneurship models (Nambisan et al., 2017) – flat governance, digital-first operations, minimal fixed overhead – are well suited to student-led innovation in resource-constrained contexts. At LUM University (Southern Italy), a sociodigital ecosystem of mentoring, digital communities and project-based activities has progressively enabled students to move from participation to initiative, opening space for the emergence of student-led spin-offs. A companion contribution to IFKAD 2026 analyses this ecosystem as a continuous mentoring system; here we extend the focus by introducing

the circular talent economy framework and by examining how lightweight spin-off teams can translate student capabilities into circular innovation projects. The study adopts a qualitative single case study design in line with Yin (2018), focusing on the Engineering Department at LUM University as a micro-level circular talent ecosystem. Data sources include internal project documents on mentoring and student engagement, participation data from student initiatives, early usage data from the *iMENSA* prototype, and informal interviews and observations involving students, faculty mentors and institutional partners. Within this context, *Ingenium* emerged as a student-led lightweight spin-off team. It operates with an extremely flat structure – no formal incorporation, no fixed facilities – and leverages existing departmental infrastructures (courses, digital channels, events) while members maintain full academic commitments. Rather than managing isolated projects, *Ingenium* works through short experimentation loops: problems sensed in the student or territorial context are scoped in terms of magnitude, addressed through small, time-bounded prototypes, and then refined on the basis of quantitative traces (participation, engagement) and qualitative feedback. Over two years, this configuration has generated a stable core and alumni team, a portfolio of events and hackathons, institutional partnerships and recognitions in regional and national competitions.

These elements are interpreted as outputs of the circular talent ecosystem rather than as final impact measures. *Ingenium*'s flagship project, *iMENSA*, is one of the exemplifies. Theoretically, the paper introduces and applies the circular talent economy framework to a peripheral university context, showing how student human capital can be mobilised through lightweight spin-off teams that connect education, entrepreneurship and circular innovation. Methodologically, the work illustrates how a student-led team can function as an experimentation platform where problems, data and projects circulate in iterative loops, creating early evidence of talent activation without requiring a full incubation

infrastructure (Etzkowitz & Leydesdorff, 2000; Nambisan et al., 2017). The current evidence remains at the level of ecosystem outputs – such as team formation, project portfolio, partnerships and recognitions – and does not yet include systematically measured outcomes.

These limitations are explicitly acknowledged and prevent us from claiming that talent and material loops are already closed; instead, we frame the present work as an early-stage exploration of how such loops can be engineered. The study is limited to a single department and is authored by researchers directly involved in the initiative, which may introduce bias. Future research will therefore include longitudinal tracking of Ingenium members' trajectories compared to regional baselines, systematic measurement and a more detailed analysis of governance and routines within lightweight spin-off teams. These developments aim to assess to what extent circular talent ecosystems can effectively counter brain drain while supporting circular economy transitions in Southern European regions.

Keywords

Circular economy; talent retention; lightweight entrepreneurship; Student spin-off; sociodigital ecosystems.

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ARTIFICIAL INTELLIGENCE IN LITERARY EDUCATION

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Abstract

Over the past decade, the relationship between digital technologies and the humanities has progressively moved beyond the traditional dichotomy between “technophobia” and “digital utopia.” In particular, Artificial Intelligence has evolved from a mere computational tool into a potential cultural mediator within literary education. This evolution is situated within the broader development of AI applications in educational contexts, widely documented in the international literature (Zawacki-Richter, 2019). While literature has historically been considered the domain of subjectivity and interpretative depth, the integration of AI into educational settings raises a crucial pedagogical question: can algorithmic systems enhance interpretative practices without compromising their critical essence? To investigate this transformation, the present study proposes a literature review covering the period 2015–2025. Searches were conducted in Scopus, Web of Science, and Google Scholar using combinations of the keywords “Generative AI”, “Large Language Models”, “Literary Education”, “Critical Thinking”, “Scaffolding”, and “AI Literacy.” The initial search identified 247 publications. After applying inclusion criteria (English or Italian language; empirical studies on the integration of LLMs in educational contexts; theoretical contributions ad-

addressing pedagogical or ethical implications of AI in the humanities) and exclusion criteria (purely technical studies without explicit educational impact; non-peer-reviewed contributions), 62 articles were selected for qualitative synthesis. The analysis followed a thematic categorization approach aimed at identifying recurring pedagogical models, reported learning outcomes, and key critical issues. The findings reveal a significant shift: from the use of AI as a tool for distant textual analysis, in line with Moretti's (2013) concept of "distant reading", to its use as dialogic support in close reading practices. Studies published between 2022 and 2025 further highlight AI's contribution to inclusion: text simplification tools and adaptive feedback systems improve accessibility for students with diverse linguistic backgrounds or specific learning disabilities, while preserving interpretative depth. Across the reviewed literature, a recurring pedagogical configuration emerges in which AI-mediated dialogue encourages students to question, verify, and refine their interpretations rather than passively accept authoritative readings. However, as Holmes (2022) emphasizes, the integration of AI into educational contexts requires critical reflection on ethical risks, algorithmic bias, and implications for cognitive autonomy. Rather than replacing interpretative work, AI appears to stimulate close reading practices aimed at validating or challenging generated responses. The review suggests that AI in literary education is undergoing a process of pedagogical "humanization", increasingly functioning as a form of scaffolding that supports student autonomy while maintaining the centrality of human interpretation. From this perspective, the need for structured AI Literacy programs emerges clearly (Luckin, 2022), capable of explicitly addressing epistemic limitations, bias, and ethical implications, ensuring that technological innovation remains aligned with humanistic values.

Keywords

AI, digital, humanities, literary, teacher.

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INCLUSION AND SKILLS DEVELOPMENT IN PRIMARY SCHOOL THROUGH DIGITAL MUSICAL STORYTELLING: A QUALITATIVE AND QUANTITATIVE STUDY IN A YEAR 4 CLASS

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Abstract

This study analyses the potential of digital musical storytelling as an inclusive teaching tool in primary schools, with a particular focus on the development of peer collaboration and the perception of inclusion. The research was conducted in a primary school in Naples, in the Vomero district, and involved six Year 4 classes comprising a total of 119 pupils, divided into an experimental group ($n = 60$) and a control group ($n = 59$). Each group included pupils with special educational needs, specifically those with dysgraphia and pupils from migrant backgrounds. The six-week intervention in the experimental group was based on collaborative methodologies, creative writing, musical storytelling and the use of the Suno app to transform texts into musical pieces, whilst the control group undertook more traditional activities involving reading, comprehension and individual written production. Teachers involved in the experimental activities received preliminary guidance on the pedagogical use of Suno and acted throughout the intervention as facilitators of collaborative, creative and inclusive learning processes. The research adopted a mixed-methods approach, integrating quantitative and qualitative tools. On the quantitative front, an adapted version of the Collaborative Learning Scale and a scale derived from the indicators of the Index for Inclusion were administered before and after the intervention. Quantitative

data were analysed through descriptive statistics, paired-samples t-tests and independent-samples t-tests. On the qualitative front, systematic observations, semi-structured interviews with students and teachers, a logbook and analysis of the products created were employed. Qualitative data were analysed through thematic analysis. The results highlight a significant improvement in the experimental group in both peer collaboration and the perception of inclusion. In particular, peer collaboration increased from $M = 2.1$ ($SD = 0.42$) to $M = 2.7$ ($SD = 0.30$), corresponding to an increase of 28.5% ($t(59) = 6.84$, $p < .001$, Cohen's $d = 0.88$), while perception of inclusion improved from $M = 2.2$ ($SD = 0.38$) to $M = 2.8$ ($SD = 0.27$), with an increase of 27.3% ($t(59) = 7.12$, $p < .001$, Cohen's $d = 0.91$). More limited improvements emerged in the control group. These results appear particularly relevant in the subgroup of pupils with SEN, who showed greater progress and a reduction in the internal variability of scores. Qualitative analysis also confirms greater emotional engagement, a stronger sense of belonging and a more collaborative relational climate in the experimental group. Overall, the study demonstrates how the integration of narrative, musical and digital languages can constitute an effective strategy for promoting more inclusive, participatory and motivating learning environments, contributing to the development of cross-curricular skills and the celebration of diversity in primary schools. However, the study is limited by the relatively short duration of the intervention and by the specific geographical context of the sample, suggesting the need for broader and longitudinal future research involving different educational settings.

Keywords

Inclusion; Primary School; Digital Teaching.

ASSESSING THE SOCIAL IMPACT OF A SOCIAL-EMOTIONAL LEARNING PROGRAMME IN LOWER SECONDARY SCHOOLS

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In recent years, assessing the social impact of educational interventions has become a central theme in educational research and policy, particularly in school contexts characterised by increasing social and cultural complexity. This study analyses the effectiveness of a structured social and emotional learning intervention implemented in lower secondary schools.

A randomised experimental design was adopted, comprising an experimental group and a control group, with pre-test and post-test assessments. The sample consisted of 120 students (aged 11–13) from two Italian schools. The students were randomly assigned to the experimental group (n=60), which participated in a twelve-week Social and Emotional Learning programme, and to the control group (n=60), which followed the standard curriculum.

The variables analysed include social-emotional skills, school well-being and engagement in school activities. Instruments validated in the international literature were used, including the Social Skills Improvement System (SSIS), the Strengths and Difficulties Questionnaire (SDQ) and the Student Engagement Scale.

The quantitative approach was supplemented with qualitative data collected through focus groups and students’ reflective diaries.

The results highlight statistically significant improvements in the experimental group compared to the control group across all dimensions

analysed. The qualitative analysis also reveals perceived changes in relational dynamics and school participation.

The study contributes to methodological reflection on the assessment of the social impact of educational interventions and on the conditions that favour the replicability and transferability of intervention models.

Keywords

Social Learning; Emotional Learning; Secondary School.

FROM VIRALITY TO INCLUSION: DESIGNING INCLUSIVE EDUCATIONAL MICRO-CONTENT ON SOCIAL MEDIA TO REDUCE COGNITIVE INEQUALITIES IN LEARNING

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Abstract

This study investigates the impact of Inclusive Microlearning Design on social media-mediated learning processes, with the aim of verifying whether an inclusive educational design can improve cognitive accessibility, engagement and equity in learning outcomes. Grounded in Cognitive Load Theory (Sweller, 2020) and multimedia learning principles (Mayer, 2021), the study integrates microlearning, inclusive education and cognitive psychology within social media-based educational environments. A mixed-methods quasi-experimental design was adopted involving 150 upper secondary school students divided into a control group (traditional teacher-centred instruction) and an experimental group exposed to inclusive, multimodal and interactive micro-content. The intervention lasted four months and focused on the teaching of *I Promessi Sposi* through structured microlearning activities delivered within regular curricular lessons. Quantitative data were collected using the Perceptions of Inclusion Questionnaire – Student Version (PIQ-S), the Utrecht Work Engagement Scale – Student Version (UWES-S), and ad hoc learning achievement tests. Qualitative data were obtained through focus groups analysed using thematic analysis. The results show significant improvements in the experimental group compared to the control group in terms of learning outcomes (82% vs 68%; $d = 0.80$), engagement (78% vs 64%; $d = 0.65$) and perception of inclusion (81% vs 70%; $d = 0.55$).

Particularly relevant effects emerged among the subgroup of students with dyslexia ($n = 6$; three in each group), suggesting a positive impact on reducing cognitive inequalities. Qualitative evidence highlighted greater comprehensibility of content, reduced perceived cognitive load and increased active participation. The study contributes to the current debate on inclusive digital learning by proposing and empirically validating Inclusive Microlearning Design as a pedagogical framework for the creation of educational social media content, highlighting the role of instructional design in transforming social media environments into more accessible, participatory and equitable learning spaces.

Keywords

inclusion; social media; microlearning; cognitive load; engagement; digital learning; mixed methods

EXPLORING AWARENESS AND ATTITUDES TOWARD MASSIVE OPEN ONLINE COURSES AMONG LEARNERS IN NON-METROPOLITAN CITIES OF INDIA

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Abstract

The democratisation of education necessitated remarkable access to quality learning resources across geographical boundaries. Massive Open Online Courses (MOOCs) have emerged as a transforming force for it (Bhardwaj & Saxena, 2024). In the Indian context, SWAYAM is one of the well-known MOOC portals that has augmented a collaborative learning space for the learners to enhance the quality of education (Vasudevan et al., 2024). However, the extent and acceptance of MOOCs in non-metro cities have been unexplored. This study aims to fill this gap and explore learners' awareness, attitudes, and challenges regarding the MOOCs platform. The Unified Theory of Acceptance and Use of Technology (UTAUT) framework supported this study by examining learners' awareness and attitude, which positively affect the technological integration in teaching and learning (Venkatesh et al., 2003). The researchers adopted a quantitative approach, using a structured survey to gather data. A Simple random sampling technique was employed, and data were collected from 300 respondents through a self-developed questionnaire using a five-point Likert scale across several educational levels, including undergraduate, postgraduate, and doctoral levels, from the eastern region of Uttar Pradesh, India. The tool was validated through expert review to establish content validity, and its reliability was assessed using Cronbach's alpha ($\alpha = .807$),

indicating good reliability. The data were analysed using descriptive statistics, including frequency, mean, standard deviation, and inferential statistics, including t-tests to compare males and females, F-tests to compare levels of courses, and regression to determine the effect of attitude for future adoption, using SPSS (version 27.0.1) software. The findings showed that a significant majority of learners demonstrated a positive attitude toward MOOCs ($M = 3.6707$), and recognised their capacity as a flexible, accessible, and affordable platform for quality education. Despite the positive attitude of the respondents, the study also revealed several challenges faced by learners in the non-metropolitan region ($M = 3.5013$), including a lack of guidance, inadequate infrastructure, the unavailability of personal devices, poor internet connectivity, lack of in-person interaction and time constraints. Some of the challenges identified in this study by the researchers align with those identified in a previous study by Kulkarni et al. (2025). The implications of the study could be helpful for policymakers and administrators, as policymakers can formulate policies to provide digital equipment to non-metropolitan learners, provide economic support to institutions to organise MOOC workshops, and facilitate learners with smart classrooms at the college level.

Keywords

MOOCs, SWAYAM, Personalised Learning, Digital Learning, NPTEL.

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THE CONTRIBUTION OF INTERACTIVE DIGITAL TECHNOLOGIES IN SPECIAL EDUCATION

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Abstract

This study investigates the impact of a laboratory-based educational intervention grounded in cooperative learning principles, inclusive pedagogy, and interactive digital learning environments on students' participation and inclusion in primary school settings. The research adopted a mixed-methods quasi-experimental design involving 56 fourth-grade students, including 10 students with special educational needs, divided into an experimental group and a control group. The experimental group participated in a fourteen-session collaborative laboratory based on the use of Book Creator, while the control group followed traditional curricular activities. Within the intervention, students collaboratively designed interactive multimodal digital books integrating texts, images, audio recordings, narrative elements and interactive activities through Book Creator, used as a collaborative and creative digital environment rather than a simple reading platform. The laboratory was structured according to project-based and cooperative learning approaches aimed at fostering active participation, peer collaboration and inclusive interaction. Data collection integrated quantitative and qualitative methods. Quantitative data were gathered through the Index for Inclusion Questionnaire administered in pre-test and post-test phases and analyzed using paired-samples t-tests. Qualitative data were collected through systematic classroom observations and focus groups with students and analyzed through thematic analysis. The findings revealed statistically significant improvements in perceived

inclusion, participation in classroom activities and quality of peer relationships within the experimental group compared to the control group. Qualitative findings confirmed improvements in classroom climate, collaborative dynamics and students' engagement, particularly among students with special educational needs. The study suggests that the integration of cooperative learning, laboratory-based pedagogy and interactive digital technologies may represent an effective strategy for promoting inclusive and participatory learning environments in primary education. However, the study is limited by the relatively small sample size and the short duration of the intervention. Future research should involve broader educational contexts and longitudinal designs in order to explore the long-term impact of interactive digital learning environments on inclusion and student participation.

Keywords

inclusion; cooperative learning; interactive digital technologies

WHERE NATURE EMBRACES THE ALGORITHM: AI-ENHANCED OUTDOOR EDUCATION BETWEEN ALGORITHMIC TRIANGULATION AND NEW VISUAL PARADIGMS

Salvatore Mancarella

Abstract

In an age profoundly shaped by social acceleration (Rosa, 2015) and pervasive digital transformation (Rivoltella, 2023), educational systems are increasingly confronted with forms of spatial-temporal compression that risk severing individuals from both ecological environments and meaningful social relations. Within this framework, Outdoor Education (OE), enriched through the integration of Artificial Intelligence (AI), emerges not merely as an alternative pedagogical methodology, but as a regenerative epistemological paradigm capable of reconfiguring the relationship between human beings, technology, and the living world. This article investigates the intersection at which nature encounters algorithmic mediation, proposing a theoretical synthesis between embodied sensory experience and computational intelligence. The central argument advanced in this paper is that AI-integrated Outdoor Education can generate a transformative ecological pedagogy through the process of algorithmic triangulation, thereby contributing an original framework to international debates on postdigital education by overcoming the dualism between techno-deterministic and neo-romantic conceptions of learning.

At the core of this framework lies the concept of algorithmic triangulation: an epistemological mediatory space situated between direct sensory immersion – the body inhabiting the world – and algorithmic data processing. This process requires a dynamic equilibrium between denotative rigor, ensured by the analytical precision of intelligent systems, and

semantic depth, generated through multisensory, relational, and situated experiences in natural environments. From this perspective, the algorithmic self is reconceptualized as an active node within a co-evolutionary network in which learning emerges through continuous interactions among human beings, technological systems, and ecosystems (Paparella & Mancarella, 2025). Particular attention is devoted to the epistemology of the visual. Moving beyond a reductive interpretation of images, maps, and simulations as merely auxiliary teaching tools, the study critically interrogates the pedagogical status of visibility itself. The article argues that images function not only as representations of reality, but also as epistemic and pedagogical dispositifs capable of interrogating, mediating, and co-constructing meaning. In this perspective, AI acts as a cognitive and perceptual amplifier, enabling learners to discern ecological interdependencies, latent environmental patterns, and systemic relations that would otherwise remain imperceptible. Drawing on experiential laboratories and service-learning practices implemented in outdoor contexts, the study demonstrates how immersive AI-supported technologies can foster transformative, participatory, and sustainability-oriented learning trajectories. Finally, the article redefines the entrepreneurial teacher as a facilitator of complex educational ecologies and advocates for renewed models of teacher education capable of integrating nature, culture, visual literacy, and intelligent technologies in order to cultivate a critically informed and ecologically grounded form of planetary citizenship.

Keywords

Algorithmic triangulation, denotative rigor, Algorithmic Self, AI, Visual Literacy, entrepreneurial teacher

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LARGE LANGUAGE MODEL FOR PSYCHO-COUNSELING: LEARNING TO GENERATE COUNSELING RESPONSES

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Abstract

This study aims to address the limitations of general-purpose large language models (LLMs) in domain-specific applications by developing a model tailored to psychological counseling. While recent advancements in Natural Language Processing (NLP) and LLMs have significantly improved automated language understanding and generation, existing models such as GPT-4 and PaLM are primarily trained on general-domain corpora and lack specialized knowledge in mental health and counseling contexts. This gap limits their effectiveness in providing empathetic, context-aware, and clinically appropriate responses. To overcome these challenges, we propose a domain-adapted LLM specifically designed for psychological counseling tasks. The model is trained on curated datasets that incorporate counseling dialogues, empathetic response patterns, and psychoeducational content, enabling it to generate more supportive and context-sensitive outputs. Additionally, parameter efficient fine-tuning techniques are utilized to reduce computational cost while maintaining strong performance. The proposed model aims to enhance the quality of AI-assisted mental health support by improving empathy, coherence, and relevance in generated responses. This work contributes to the growing field of AI-assisted mental health support and demonstrates the potential of specialized LLMs in delivering more effective and responsible psychological assistance.

Keywords

Psychological Counseling · Artificial Intelligence · Natural Language Processing · Large Language Model

Introduction

Natural Language Processing (NLP) is a branch of Artificial Intelligence (AI) which enables computers to analyze and synthesize natural (human) language and speech [6]. Technological advances in natural language processing in the past two decades have made it easier than ever for psychologists to incorporate language analysis in their work [3]. Natural language processing (NLP) aims to enable computers to understand human language in both spoken and written forms. State-of-the-art NLP methods are based on large language models (LLMs), which, while primarily designed for text generation, can also be used for information extraction and prediction tasks [2]. Large language models (LLMs) are artificial intelligence (AI) systems that are trained on billions of words derived from articles, books and other internet-based content [8]. LLMs can leverage their vast knowledge and language capabilities to engage in conversations and provide support. However, models such as GPT-4 and PaLM are primarily trained on general-purpose datasets and often lack specific expertise in psychological counseling [7]. To address these limitations and contribute to the field, this study presents the development of a large language model tailored for the domain of psychological counseling.

Methodology

This study builds upon the Qwen language model series, a set of models with varying parameter scales [1]. To enhance domain-specific performance, we apply fine-tuning to improve the model's understanding based on pre-training knowledge [9]. In particular, we use Low-Rank Adaptation (LoRA) [4], a parameter efficient method that reduces the number of trainable parameters while maintaining competitive performance [5]. For training, we utilize the PsychoCounselPreference dataset [10], which aligns with professional psychotherapists' preferences and supports model evaluation in psychological counseling tasks.

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EMPOWERING SOCIAL SCIENCES: DIGITAL STRATEGIC SKILLS AS A LEVER FOR STARTUPS AND EQUALITY.

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1. Introduction: Research Rationale and Originality

This study explores an innovative multidisciplinary institutional framework transforming academic project works into sustainable startups by re-defining digital strategic skills and information literacy not just as a tool for civic defense, but as structural requirements for modern entrepreneurship in complex socio-economic systems. Through the analysis of the *DigiFun-Collab* ERASMUS+ KA2 Project experimental framework, this contribution investigates a mixed instructional model that repurposes digital literacies into proactive entrepreneurial tools for the creation of social-value-oriented startups. The research proposes a systemic blueprint for a “Placement 2.0”, here defined as an active university-led incubation ecosystem that evolves traditional career services into a proactive professional co-creation model through digital micro-credentials. The model builds upon, yet distinctly extends, traditional placement services, established service-learning approaches (Bringle & Hatcher, 1995) and entrepreneurship education models (Neck & Greene, 2011) by embedding formal digital certification as a structural employability lever. This approach bridges the gap between digital democratization, institutional evolution, and the legal-economic empowerment of marginalized populations. By leveraging the University’s Third Mission (Etzkowitz & Leydesdorff, 2000), the paper demonstrates how digital democratization through access to high-level digital expertise and formal certifications serves as a primary lever for substantive equality, bridging socio-economic gaps and fostering professional self-determination in line with the UN 2030 Agenda (2015).

2. Nexus between Digital, Economic, and Legal Frameworks

The research adopts a mixed-methods case study design, integrating qualitative focus groups with national stakeholders and quantitative pre- and post-intervention assessments to evaluate students' digital and entrepreneurial competencies.

The educational intervention, at the intersection between digital, economics and law, is grounded in a mixed instructional design that integrates rigorous theoretical foundations in management, economics, and business administration with the development of transversal digital and soft skills. By simulating real-world business scenarios in high-social-value sectors such as the Green Economy and the Third Sector, students convert academic knowledge into "spendable" currency in modern workplaces, validated through formal certifications and EU Open Badges (Vuorikari et al., 2022) (239 total certifications: 195 participants, 44 mentors). Preliminary analysis of learning outcomes through evaluation rubrics indicates, among assessed participants, a positive shift in self-perceived entrepreneurial intent, alongside demonstrated progression of at least one DigComp 2.2 proficiency level, while project validation by 15 international stakeholders confirmed the entrepreneurial viability of the proposed models. Framing digital skills for modern entrepreneurs includes the strategic use of digital marketing and e-commerce to build effective communication plans capable of attracting investors, engaging stakeholders and penetrating global markets at low costs (Benkler, 2006). Furthermore, training in Information Literacy (UNESCO, 2021) enables aspiring entrepreneurs to navigate the overwhelming "information tide" to identify competitors, market niches, and innovative funding opportunities, like crowdfunding and prototype-based pre-orders, significantly reducing initial investment risks and storage costs. Beyond economic efficiency, this model carries a legal-constitutional dimension grounded in the principle of substantive equality. By empowering students to follow their natural inclinations and materialize their

vision, the University facilitates the “full development of the human person”, a fundamental principle enshrined in international democratic frameworks (European Union, 1966; 2012; 2017). The strategic use of information and digital resources acts as a powerful lever for equity. Access to open certifications, MOOCs, and digital tools operationalizes the removal of socio-economic barriers to education (UNESCO, 1960), enabling individuals from disadvantaged backgrounds to bridge gaps in wealth, prior training and geographic isolation.

Implementation challenges emerged, including cross-country regulatory heterogeneity and technological barriers, which may affect immediate generalizability. These limitations were partially mitigated through differentiated instructional pathways. However, reliance on a single project context suggests caution in extending the results, although the general model’s scalability appears consistent. By providing access to flexible, high-level training opportunities, the digital medium democratizes access to high-level learning opportunities, ensuring that geographical or professional constraints do not limit individual potential. The systematic investment in the skills and knowledge of the population is the primary driver of national economic development and productivity (Becker, 1993). In this sense, raising the collective educational level is not only a matter of social justice but a strategic economic necessity that enhances the country’s overall competitiveness and GDP, fostering a more inclusive society.

Finally, a robust information and digital literacy constitutes a fundamental form of active and digital citizenship. Cultivating “out of the box” thinking enables students and citizens to become less vulnerable to informative manipulation and more capable of selecting reliable sources (UNESCO, 2016). In a volatile and ever-changing labor market, upskilling and reskilling are essential for individual growth and professional sustainability, impacting all individual life dimensions, including citizenship.

3. Conclusions

Ultimately, this model demonstrates how the synergy between institutional proactivity, legal-constitutional principles, and digital strategic competence can transform the "right to study" into a real "right to professional self-determination" (Sen, 1999), ensuring that education serves as a vehicle for social-value-oriented and sustainable economic and entrepreneurial models, economic innovation, and human fulfillment. This framework directly contributes to the United Nations 2030 Agenda (2015), specifically addressing SDG 4 (Quality Education) (2016) and SDG 8 (Decent Work and Economic Growth) (United Nations, 2015) acting as a replicable blueprint for professional empowerment in global educational ecosystems.

Keywords

Sustainable Entrepreneurship; Digital Strategic Skills and Information Literacy; University Third Mission and "Placement 2.0"; Substantive Equality; Social Sciences Empowerment.

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ENHANCING PERCEIVED SOFT SKILLS THROUGH THYMIO ROBOTS: A PILOT STUDY USING A SCIENCE-THEMED EDUCATIONAL ESCAPE GAME

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1. Introduction

Educational robotics and escape games separately have increasingly been recognized as a promising approach to supporting children's transversal competencies. Giang et al. (2018) showed that their combination can offer an ideal environment for teaching and learning by supporting collaboration and active problem solving. This framework informed the development of our own science-themed escape game with Thymio robots and a visual programming language. In our previous conference contribution, Chinzer et al. (2025) reported encouraging results in terms of engagement and feasibility with younger novice learners. Inal and Cagiltay (2007) showed that children's engagement in game-based contexts depends strongly on the balance between challenge and support. On this basis, before extending the redesigned protocol to whole classrooms, we conducted a preliminary pilot study. This pilot, based on iterative data-driven approach, aimed to assess feasibility, identify aspects of the intervention requiring refinement, and calibrate the protocol prior to a large-scale implementation.

2. Methodology

The pilot involved seven children aged 8 to 11 ($M = 9.86$, $SD = 0.90$), who were organized into two groups for three increasingly difficult sessions.

Each session included a narrative video, four minigames, and a final programming phase with VPL and Thymio robots. The four minigames (i.e., Arithmetic, Netwalk, Sudoku, and Morse) were designed as preparatory steps for the final programming phase with Thymio robots and targeted skills such as logical reasoning, planning, selective attention, and decoding. They also allowed children to obtain the codes needed to unlock the boxes in which the Thymios were placed. Data collection combined pre- and post-session measures of perceived soft skills covering ten dimensions: self-confidence, openness, autonomy, collaboration, leadership, engagement, curiosity, problem solving, empathy, and resilience (Lucisano & Rubat du M rac, 2019) and self-efficacy.

It also included post-session measures of flow (Rheinberg et al., 2023), motivation (Guay et al., 2000), and narrative transportability (Jensen et al., 2016), together with mini-games' activity logs and field observations. All questionnaires were administered with researcher supported reading and age-appropriate explanations when needed.

3. Preliminary Results and Discussion

The pilot confirmed a positive reception by participants and provided useful indications for the refinement of the intervention. Perceived soft skills showed a descriptive increase from pre- to post-intervention, from $M = 3.68$ to $M = 4.08$. Given the very small pilot sample, the results were considered exploratory and should not be interpreted as evidence of effectiveness. Therefore, these results were used primarily to inform the redesign of the intervention rather than to draw generalizable conclusions. As session difficulty increased, Netwalk and Sudoku proved the most demanding, while Morse became easier after additional support was introduced. These findings guided adjustments to time limits, penalties, session duration, and task-specific support strategies. In this sense, the pilot contributed meaningfully to the development of a more balanced and refined intervention to be tested in a future large-scale

implementation. Despite the limitations imposed by the small sample size, the potential impact of the approach is considerable. The developed protocol, once validated on a large scale, could offer a concrete tool for educators and researchers interested in promoting soft skills and computational thinking in primary school through game-based experiential approaches.

Keywords

Educational robotics; Escape game; Thymio robots; Visual programming language; Game-based learning

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GAME MECHANICS AS LEARNING SCAFFOLDS: A CONCEPTUAL FRAMEWORK FOR PROBLEM SOLVING THROUGH GAME-BASED LEARNING

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Keywords

*game-based learning; problem solving; game mechanics; learning processes;
purposeful play; primary education*

Problem solving is a central construct in educational research, recognised across disciplinary boundaries as a key competence for lifelong learning and one of the most demanding areas of instructional design (Csapó & Funke, 2017; OECD, 2014). The interest in problem solving extends beyond any single subject domain: it involves flexible thinking, strategic reasoning, self-regulation, and the capacity to transfer learning across contexts (Hattie, 2009; Laurillard, 2012). At the same time, game-based learning (GBL) has gained increasing attention as a pedagogical approach capable of fostering engagement, motivation, and deeper cognitive processing (Plass et al., 2015). Yet, despite a growing body of literature on both problem solving and serious games, the intersection between the two remains undertheorised. Most existing contributions focus on gamification as an external motivational layer – points, badges, and leaderboards – rather than examining how the intrinsic mechanics of games may structurally support the cognitive and metacognitive processes that underpin learning through problem solving.

This contribution proposes a conceptual framework that explores the potential relationships between core game mechanics and the pro-

cesses underlying problem solving as a learning activity, drawing on both classical problem-solving theory (Polya, 1945; Schoenfeld, 1985) and broader models of self-regulated learning and strategic thinking. The framework identifies areas of structural resonance between game environments and problem-solving activity – understood as potential affordances rather than fixed equivalences, acknowledging that such relationships are mediated by context, task design, and the learner’s own activity. While the framework is developed with particular reference to mathematical problem solving in primary education – a domain where the tension between cognitive demand and learner engagement is especially acute – its conceptual architecture is designed to be applicable to problem-solving processes across different curricular areas.

A central distinction in the framework is between surface-level gamification – the addition of extrinsic reward systems to existing tasks – and deep ludic design, understood as the structural integration of game mechanics into the learning experience itself. This distinction is particularly relevant in primary education, where the risk of trivializing complex reasoning through superficial game elements is high. Deep ludic design, by contrast, leverages what Salen and Zimmerman (2004) describe as “meaningful play” – the condition in which a player’s actions are both discernible and integrated within the larger game system – as a productive space for sense-making and knowledge construction. The framework is intended to serve as a heuristic tool for educators and researchers developing game based learning interventions, offering a principled yet flexible basis for aligning game design choices with cognitive and metacognitive learning goals.

Implications are discussed for instructional design and future empirical research aimed at investigating the proposed framework across different game formats – including board games, card games, digital applications, and hybrid environments – and across different learning domains and levels of problem-solving complexity.

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THE ROLE OF MALADAPTIVE COPING IN THE RELATIONSHIP BETWEEN INTERNALIZING SYMPTOMS AND SOMATIZATION AMONG UNIVERSITY STUDENTS

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Abstract

Background: Internalizing symptoms are closely linked to somatic complaints among university students, yet the role of coping remains theoretically ambiguous. Drawing on transactional stress-coping (Lazarus and Folkman, 1984), strategy-stressor fit (DeLongis and Holtzman, 2005; Taylor and Stanton, 2007), and perseverative-cognition/emotion-regulation perspectives (Brosschot et al., 2006; Aldao et al., 2010), this study tested whether adaptive and maladaptive coping moderate, or more directly predict, the relationship between internalizing symptoms and somatization.

Methods: Undergraduate students at Southern Illinois University Edwardsville were recruited through the psychology SONA system and completed an anonymous 20-minute Qualtrics survey ($N = 83$; 53 females, 63.9%; 30 males, 36.1%; age range = 18-39 years, $M = 19.87$, $SD = 2.95$; year of study not collected). Analytic sample sizes ranged from 69 to 81 because of item level missingness. Depression and anxiety were measured with the validated Patient Health Questionnaire-9 ($\alpha = .88$) (Kroenke et al., 2001) and Generalized Anxiety Disorder-7 scale ($\alpha = .93$) (Spitzer et al., 2006). Somatization was measured with the validated Somatic Symptom Scale-8 ($\alpha = .84$) (Gierk et al., 2014) and Pain Catastrophizing Scale ($\alpha = .95$) (Sullivan et al., 1995). Coping was measured with the validated Brief COPE Inventory (Carver, 1997). Adaptive coping ($\alpha = .88$) was operationalized as active coping, planning, positive reframing, acceptance, emotional/in-

strumental support, humor, and religion; maladaptive coping ($\alpha = .84$) as self-distraction, denial, substance use, behavioral disengagement, venting, and self-blame. Standardized PHQ-9/GAD-7 scores formed the internalizing composite, and standardized SSS-8/PCS scores formed the somatization composite. Moderation was tested using separate hierarchical regressions with centered interaction terms and age/gender covariates.

Results: Mean item scores were $M = 2.26$ for GAD-7, $M = 2.04$ for PHQ-9, $M = 1.97$ for SSS-8, and $M = 1.65$ for PCS on the effective 1–4 scale. Internalizing symptoms were strongly correlated with somatization ($r = .84$, $p < .001$). Neither adaptive coping ($N = 69$, interaction $\beta = .042$, $p = .550$, $\Delta R^2 = .002$, final $R^2 = .746$) nor maladaptive coping ($N = 74$, interaction $\beta = .037$, $p = .568$, $\Delta R^2 = .001$, final $R^2 = .757$) significantly moderated this association. In the maladaptive coping model, internalizing symptoms ($\beta = .650$, $p < .001$) and maladaptive coping ($\beta = .218$, $p = .013$) independently predicted somatization, whereas adaptive coping was not a significant independent predictor ($\beta = .004$, $p = .956$).

Conclusion: The findings do not support a broad moderation model of coping. Instead, maladaptive coping appears to provide a more parsimonious direct pathway to somatic symptom burden beyond anxiety and depression, consistent with theoretical accounts emphasizing perseverative cognition and poorly matched emotion-regulation strategies. Because the study was cross-sectional and limited by modest sample size and response-scale export constraints for the SSS-8 and PCS, longitudinal research with larger samples should test mediation, contextual coping fit, and causal ordering.

Keywords

internalizing symptoms; somatization; coping strategies; anxiety; depression; university students

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MINIGAME CREATION AS A STRATEGY FOR SOCIAL MEDIA LITERACY: A PARTICIPATORY APPROACH TO SUSTAINABLE ENTREPRENEURSHIP AND SKILL DEVELOPMENT

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1. Introduction

In the context of a growing impact of social media on young people's lives (Vandenbosch et al. 2025), fostering critical digital literacy has become a key educational challenge (Theophilou, 2022). This paper provides an overview of an exploratory study on online games creation as innovative pedagogical strategy to address issues such as the non-intended effects of social media use among youngsters. Framed within the theme of sustainable entrepreneurship and skill development, the premise of the study positions students not only as learners but also as active creators of educational solutions with social impact. Through this approach, students develop transversal competencies such as critical thinking, creativity, collaboration, and digital design skills, which are essential for sustainable and socially responsible innovation (Romero, 2026).

2. Methods

The research adopts a Participatory Action Research (PAR) approach (Cornish, 2023) engaging students as co-researchers in identifying challenges related to social media use and designing educational minigames to address them. The study involved 18 undergraduate students from Computer Engineering and Audiovisual Systems degrees who over the course of one academic year and across multiple iterative co-design, development, and implementation sessions, participated in different research and develop-

ment sessions and implemented the designed game in a real setting of media literacy. This methodological framework emphasized iterative design, reflection, and collaborative problem-solving, aligned with sustainable entrepreneurship principles. Data collection included: (1) the minigames developed by students, (2) project reports and reflective self-assessment notes, and (3) teaching staff evaluations of the process and outcomes. A qualitative analysis with Atlas.ti was conducted following a thematic analysis approach to identify recurring themes in students' reflections, learning processes, and design outcomes.

3. Results

The findings suggest that minigame creation can serve as a meaningful context for exploring social media literacy and related competencies. From a qualitative perspective, students' work revealed a growing sensitivity to pressing digital issues, as they engaged with themes such as misinformation, digital anxiety, and online polarization, often reflecting on how these challenges shape their own online experiences and those of their peers. Moreover, the process fostered the development of technical and entrepreneurial skills, such as problem identification, user-centered design, and creative communication. The participatory nature of the project enabled students to take ownership of their learning and position themselves as agents of social change. The produced minigames reflected diverse strategies to educate peers, combining interactive storytelling, gamification, and critical reflection.

4. Discussion and Conclusion

The present study underscores the effectiveness of participatory methodologies in empowering students and enhancing the relevance of educational interventions in the digital age. By integrating student perspectives into the design process, the approach not only improves the quality and impact of the educational outputs but also contributes to the development

of responsible, critically engaged digital citizens. From the perspective of sustainable entrepreneurship, the project illustrates how educational innovation can generate socially meaningful solutions while fostering key competencies for future professionals. The results suggest that involving young people in the co-creation of learning tools can amplify their impact within their communities. As an exploratory study with a relatively small sample, the findings should be interpreted cautiously and are not intended to be generalized without further research. All in all, the creation of minigames through a participatory framework represents an effective strategy for promoting social media literacy, skill development, and sustainable, socially driven innovation. This approach not only enhances students' critical awareness but also empowers them to actively contribute to addressing contemporary digital challenges

Keywords

Critical digital literacy; Minigame-based learning; Participatory Action Research (PAR); Social media education; Sustainable entrepreneurship.

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INCLUSIVE BACKGROUND AND DIDACTIC DESIGN: A MIXED METHODS STUDY IN PRIMARY EDUCATION

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1. Introduction

This contribution presents a research project aimed at investigating the impact of didactic materials designed according to the construct of the inclusive background, as theorized by Fabio Filosofi, within primary school contexts. In this perspective, the inclusive background is understood as an implicit framework that shapes representations without explicitly thematizing diversity, functioning as a pedagogical device that promotes access, participation, and recognition. The study also draws perspectives on representation (Hall, 1997) and disability studies (Garland-Thomson, 1997; Oliver, 1996), framing inclusive background as a device that shapes how difference is perceived and normalized within educational context. Didactic materials are not limited to conveying disciplinary content; rather, they incorporate graphic and textual choices that reflect a plurality of configurations of reality, people, animals, and environments in line with an educational vision oriented toward valuing heterogeneity and overcoming homogenizing models.

2. The Inclusive Background as a Pedagogical Construct

According to the adopted theoretical framework, the inclusive background operates as a latent structure that supports the learning experience, fostering a natural and non-problematized exposure to diversity. In this sense, it contributes to the construction of educational contexts in which plurality is represented as an ordinary and constitutive dimension of experience.

3. Operationalization of the construct

The inclusive background is implemented through design choices embedded in the materials, guiding language, images, and content toward broad and non-stereotypical representations.

Preliminary classroom experimentation has also highlighted positive teacher perceptions regarding the use of the games, particularly in terms of student engagement, inclusiveness, and active participation during learning activities.

4. Methodology

The study adopts a mixed-methods approach. The quantitative component aims to assess the effectiveness of the materials in terms of early literacy learning outcomes. The quantitative component will include standardized pre-tests and post-tests developed by the Pedagogical Support Service to assess phonological awareness, phonography, and reading skills among all first-grade primary school students in the Bellinzona and Tre Valli district. The sample is expected to include approximately 843 first grade students.

The qualitative component will include a questionnaire administered to more than 100 teachers, combining closed and open-ended questions concerning inclusive teaching practices and perceived educational effects. In addition, semi-structured interviews with 10 teachers will be conducted to further explore experiences, challenges, and the educational potential of the intervention. Classroom observations will also be carried out in 4 classes through the use of structured observation grids.

The qualitative component explores teachers' perceptions regarding the use of materials and the role of inclusive representations in educational practice. Through the collection of empirical data, focus groups, and in-context observations, the study seeks to understand how tools designed according to the inclusive background framework may influence teaching-learning processes.

5. Conclusions

The materials under investigation consist of three sets of educational games designed to support early literacy development through playful approaches consistent with the principles of the inclusive background.

The intervention is based on three sets of educational games designed to support early literacy development through playful and inclusive learning approaches. The *Fonopolpo* games promote phonological and metaphonological awareness through activities focused on rhymes, syllables, phonemes, and word manipulation. The *Fonogranchio* games strengthen phonographic skills by supporting sound–symbol associations and memory processes involved in reading and writing acquisition. Finally, the *Letturana* games foster reading fluency and text comprehension through multimodal activities stimulating both phonological and lexical reading processes, as well as inferential comprehension skills.

The study is expected to highlight the potential of inclusive, game-based didactic materials to contribute to the construction of more equitable, accessible, and welcoming educational environments, while simultaneously supporting disciplinary learning and the development of inclusive attitudes.

By investigating how implicit inclusive representations influence both literacy development and classroom participation, the research aims to contribute to current debates on inclusive pedagogy and on the design of educational materials capable of normalizing diversity within everyday learning experiences.

Keywords

Inclusion; Representation; Disability.

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IMMERSIVE REALITY IN SOLID GEOMETRY EDUCATION: EFFECTS ON STUDENT LEARNING AND TRAINEE TEACHERS' PERCEPTIONS OF INCLUSIVE DIGITAL PEDAGOGY

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The integration of immersive technologies in mathematics education is increasingly recognized as a powerful approach to enhancing learning processes, particularly in domains characterized by high levels of abstraction. Solid geometry represents a critical area in which students often struggle due to the difficulty of visualizing three-dimensional structures through traditional instructional methods. In this context, immersive reality environments offer significant potential to support learning by enabling interactive, manipulable, and visually rich representations of mathematical objects. This study investigates the impact of an immersive reality-based learning environment on students' learning outcomes, motivation, and engagement in solid geometry, with particular attention to its potential for supporting inclusive and accessible learning processes. The research adopts a mixed methods design structured in two complementary phases.

The first phase consists of a quasi-experimental crossover design involving 50 lower secondary school students from two third-grade classes (25 students per class). Both groups experienced immersive and traditional instructional conditions across different solid geometry topics (e.g., cube, parallelepiped, pyramid), allowing for controlled comparison while minimizing class-related bias. The immersive intervention was implemented through PICO virtual reality headset and the Mozaik educational platform, enabling interactive exploration of

three-dimensional geometric structures. A pre-test/post-test structure was used to assess learning gains. Student achievement was measured through content-based tests, while motivation was evaluated using a scale inspired by the ARCS model (Attention, Relevance, Confidence, Satisfaction). In addition, students' perceptions of the technology were analyzed through constructs derived from the Technology Acceptance Model (TAM), namely perceived usefulness and perceived ease of use. Quantitative data were analyzed through repeated-measures ANOVA and descriptive statistics. The second phase complements the experimental study by exploring trainee teachers' perceptions of immersive technologies in mathematics education. A structured questionnaire was administered to 98 future special education teachers enrolled in secondary school teacher training programs in order to investigate their prior knowledge, attitudes toward instructional use, beliefs regarding cognitive benefits, and awareness of the potential of immersive environments to support diverse learning needs. The instrument is grounded in a tripartite model of attitudes (emotional, instructional, and cognitive) and informed by TAM, the Theory of Planned Behavior (TPB), and Technological Pedagogical Content Knowledge (TPACK). Qualitative responses were examined through thematic analysis. The study is theoretically framed by immersive learning theory, which emphasizes interaction and visualization as drivers of conceptual understanding, and by the Universal Design for Learning (UDL), which highlights the role of digital technologies in promoting accessibility, flexibility, and inclusion in educational contexts. Within this perspective, immersive environments are interpreted as tools capable of enhancing not only learning performance but also participation and engagement, particularly for students with diverse or atypical learning needs.

Results showed higher levels of learning achievement, motivation, and engagement in the immersive condition compared to traditional instruction, with statistically significant differences in post-pre test performance

($p < 0.05$). Students also reported positive perceptions regarding usability and usefulness, confirming the role of immersive technologies as effective tools for supporting mathematical understanding and visual-spatial reasoning. Furthermore, immersive environments facilitated more inclusive learning experiences by enabling multiple forms of representation and interaction. Findings related to trainee teachers revealed generally positive attitudes toward immersive technologies and strong interest in their future integration into teaching practice. However, results also highlighted a significant gap between technological acceptance and pedagogical readiness: despite recognizing the educational value of immersive tools, trainee teachers report limited formal training and insufficient methodological preparation for their effective implementation in inclusive classroom contexts. Overall, the study contributes to the "learning and technology" field by providing empirical evidence on the effectiveness of immersive environments in enhancing mathematical learning, while also highlighting the importance of aligning technological innovation with teacher preparedness. The findings support the role of immersive technologies as tools for promoting adaptive, engaging, and inclusive learning experiences, in line with current challenges in educational innovation.

Keywords

immersive learning; mathematics education; learning technologies; inclusion; student engagement

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DIVERGENT INTELLIGENCES: GIFTEDNESS AND ARTIFICIAL INTELLIGENCE AS A LEVER FOR DEVELOPING ENTREPRENEURIAL COMPETENCE IN PRIMARY SCHOOL

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The landscape of pedagogical research has long adopted a normalising perspective towards cognitive variability, interpreting difference as a deviation from the norm rather than as an expression of the richness of human potential (Trail, 2011). The present contribution proposes a shift in perspective: the profile of gifted students does not represent a condition to be brought back to expected standards, but rather a distinctive cognitive configuration, capable of generating original forms of elaboration, problemsolving, and meaning-making (Renzulli, 2005). This perspective aligns with the European EntreComp framework (Bacigalupo et al., 2013), which defines entrepreneurial competence as the capacity to transform ideas into action through creativity, critical thinking, management of uncertainty, and the valorisation of available resources. Gifted students, characterised by divergent thinking and a marked tendency towards metacognition, embody dispositions that the EntreComp framework places at the heart of the entrepreneurial mindset. Recognising and cultivating such dispositions from primary school onwards implies an investment in an educational model that transform differences into generative competences for the individual and for the community. The urgency of this orientation finds empirical grounding in the data of the “InclinA-

zione" research training project, conducted in collaboration with the University of Bari "Aldo Moro" across 10 primary school classes, involving 300 pupils and 61 teachers (Amati, 2024). The study found that fewer than half of the teacher sample was adequately prepared in legislative and scientific terms regarding giftedness, and that the Schoolwide Enrichment Model (SEM) was virtually unknown among the participating teachers. At the same time, 67% of teachers declared that they operated within an inclusive school context, whilst manifesting significant methodological gaps precisely in relation to profiles of academic excellence. These data confirm that authentic inclusion requires an explicit design competence, grounded in the systematic analysis of each pupil's learning needs. As Perla (2010) underscores, the didactics of the implicit must be brought to the surface through structured reflective processes, so that the educator can recognise and valorise that which does not fall within expected canons. The implications concern both initial and continuing teacher education, as well as the design of inclusive learning environments capable of valorising cognitive diversity as a resource for the sustainable development of competences in primary school (Zanetti, 2012).

Within this epistemological framework, the paper presents the theoretical reference framework and the design of the teaching intervention, situated within a multi-phase research process. A systematic assessment of the training needs of the teaching staff involved, and the consequent professional development action, have already been carried out through the administration of a pre-intervention questionnaire; a postintervention survey is planned at the end of the process, aimed at documenting changes in representations, attitudes, and professional practices regarding giftedness and inclusive teaching. The teaching activities, developed in collaboration with the teachers involved, will be implemented in the 2026/2027 school year and will target third and fourth grades of primary school (8-10 years old), a choice grounded in the progressive maturation, within this developmental window, of the metacognitive capacities and

abstract thinking structures essential to sustain the activities of ideation, argumentation, and redesign envisaged by the program.

At the operational level, the paper outlines a situated teaching proposal in which learners are invited to engage with authentic problems drawn from their own life context through the support of a conversational artificial intelligence system. This system poses heuristic questions, prompts the articulation and justification of choices, introduces unexpected constraints, and offers alternative interpretive perspectives, accompanying the learner through an iterative cycle of ideation, selection, critical evaluation, and redesign that reproduces the logic of entrepreneurial thinking. As Perla and Fabris (2025) highlight, AI reshapes the possibilities for personalizing learning pathways, opening new frontiers for an authentically inclusive pedagogy. The proposal has been developed in full compliance with the EU AI Act (2024/1689) and Italian Ministry Guidelines [9], ensuring transparency in the mediation of digital tools, continuous pedagogical supervision, protection of personal data privacy, and safeguarding of learners' cognitive autonomy.

The program is structured along three lines: critical thinking, cooperative learning, and metacognition. Each unit is accompanied by technical sheets bearing objectives explicitly anchored to the EntreComp framework, defined roles, and an integrated assessment system comprising evaluation rubrics referenced to the framework's indicators, structured observation protocols, analysis of students' work, and metacognitive journals. These tools are designed to document, in a systematic and reproducible manner, the developmental trajectory of entrepreneurial competences, giving teachers the possibility to move beyond the logic of additional tasks for individual students in favor of a cognitively demanding challenge for the entire class group (MIM, 2025), in which divergent thinking is configured as the authentic driving force of a pedagogy of excellence and inclusion.

Keywords: Giftedness; Entrepreneurial competence; Artificial intelligence in education; Inclusive didactics.

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SMART TECHNOLOGIES TO GUIDE EVERYONE: AI AT THE SERVICE OF INCLUSION

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Guidance represents a strategic dimension in educational and professional contexts, as it supports individuals in decision-making processes relating to training and work paths.

In a scenario characterized by rapid technological, social and economic changes, there is a need to develop inclusive guidance practices, capable of guaranteeing equal access and equal opportunities to people with different cultural backgrounds, socio-economic conditions and educational needs. In this perspective, artificial intelligence (AI) is taking on an increasingly important role in guidance services, thanks to the possibility of offering personalized supports, predictive analysis and adaptive digital tools.

The paper presents a qualitative documentary review of the scientific literature published between 2015 and 2025, conducted through the Scopus, Web of Science and ERIC databases according to the methodological principles of scoping review.

The analysis included peer-reviewed articles, institutional reports and European project documents selected according to criteria of relevance to the themes of inclusive guidance and the use of AI in educational and professional contexts.

International reports produced by UNESCO, OECD and Cedefop were also examined, together with experiences developed under the Erasmus+ and Horizon Europe programmes, with particular attention to digital career guidance systems aimed at students, vulnerable adults and people at risk of social exclusion.

The review highlights that the available evidence on the effectiveness of AI in guidance is still heterogeneous and partly limited, but allows for the identification of some recurring trends. In particular, the studies analyzed show positive results in three main areas: (a) expanding accessibility to services through chatbots, intelligent platforms and tools available remotely; (b) greater personalization of orientation routes through adaptive systems based on the analysis of user data; (c) support to professionals in the early identification of educational and training needs.

The most consistent evidence concerns users traditionally less reached by conventional services, including adult students, residents of peripheral areas and individuals with socio-economic fragility. However, the literature analyzed also points out significant limitations: many studies have small samples, short-term evaluations and poor methodological comparability, making it still difficult to generalize the results. In addition, critical issues emerge relating to the risk of algorithmic bias, the protection of personal data, the transparency of decision-making processes and possible forms of digital exclusion. In light of this evidence, the paper proposes a human-centred perspective for the integration of AI into guidance services, based on criteria of fairness, human supervision and algorithmic transparency.

AI is interpreted as a tool to support guidance professionals and not as a replacement for the educational relationship.

The study concludes by emphasizing the need to develop operational protocols, shared evaluation models and ethical guidelines capable of combining technological innovation and social inclusion, promoting more accessible, personalized and scientifically based guidance systems.

Keywords:

Inclusion, Smart technologies, Guidance

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ACADEMIC MOTIVATION, SELF-EFFICACY, AND PHYSIOLOGICAL CORRELATES OF PERFORMANCE IN UNIVERSITY STUDENTS: A MULTIMETHOD OBSERVATIONAL STUDY

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Abstract

Academic motivation and self-efficacy in coping with stressful life events are fundamental elements in the academic lives of university students. In particular, the literature shows that, in most cases of difficulty in academic performance, prodromal signs of clinically relevant symptomatology and poor management of daily routines represent risk factors for university students' well-being.

Gap in the recent literature.

Less is known about the role of visual exploration patterns and physiological arousal in information processing during the execution of tasks with a high emotional impact. It is still not entirely clear, in fact, how these indicators may help explain individual differences in performance within educational contexts aimed at enhancing academic motivation and fostering self-efficacy.

Research aims and hypotheses.

To address this gap, the present study seeks to investigate the role of visual exploration patterns and physiological arousal during the performance of a high emotional-impact task in university students involved in educational workshops. The workshops constitute the study's assess-

ment context. It is hypothesized that a more organized and sectorized visual exploration pattern, associated with a moderate level of physiological arousal, predicts better task performance. Within this model, visual exploration patterns and physiological arousal constitute the main predictors of performance, whereas academic motivation, anxiety, and self-efficacy are considered individual contextual variables.

Methods.

An exploratory, multimodal, cross-sectional observational design was adopted, with post hoc analyses of physiological and oculometric parameters in relation to performance. The sample consists of approximately 30 university students recruited within university educational workshops. Academic motivation was assessed using ad hoc instruments; additional psychological measures included anxiety, assessed through the General Anxiety Scale, and self-efficacy, assessed through the Self-Efficacy Scale. The study's dependent variables are represented by task performance and related performance indicators, such as accuracy, response times, and a composite index. The main predictors consist of eye-tracking indices of visual exploration, including number and duration of fixations, saccades, gaze dispersion, and transitions between areas of interest, as well as PPG physiological parameters, including heart rate and heart rate variability. Covariates include age, gender, and year of study. The experimental procedure consisted of an individual computerized task with high emotional impact, during which participants were presented with salient visual stimuli and asked to make decisions or select responses relevant to the task, while oculometric and physiological parameters were recorded simultaneously.

Expected results.

Consistent with the proposed hypothesis, it is expected that participants characterized by a more organized visual exploration pattern, associated with a moderate level of physiological arousal, will show better task

performance than participants with a more dispersed visual pattern and higher arousal levels. In particular, it is expected that a more efficient distribution of gaze will enable faster selection of task-relevant stimuli, reducing interference from emotionally salient but task-irrelevant elements.

Limitations.

Some limitations should be considered in interpreting the results. The administration of questionnaires during the workshops makes the interpretation of the psychological measures collected in the educational context more complex. In addition, the experimental task and performance index were developed ad hoc on the basis of the available literature and therefore require cautious interpretation. Finally, the limited sample size and the post hoc component related to the analysis of physiological patterns reduce the generalizability of the findings.

Conclusions.

The present study proposes an integrated approach to the analysis of psychological and physiological variables relevant to the academic functioning of university students. Despite the exploratory nature of the design, this contribution aims to offer useful indications for further investigating the relationship between academic motivation, self-efficacy, and the physiological correlates of performance in university educational contexts.

Keywords

Eye movements, Academic motivation, Stress, Self-efficacy, Physiological arousal

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MULTILINGUALISM AND PSYCHOLOGICAL BENEFITS

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Abstract

This paper explores the link between multilingualism and psychological well-being, with a specific focus on school settings and their potential for inclusion. Following a theoretical definition of the concept of linguistic intelligence, analysed in terms of its cognitive, metalinguistic and socio-relational components (Stanford, 2003), this paper examines the main evidence in the literature regarding the influence of multilingual competence on individuals' cognitive, affective and social development. The increasing prevalence of situations involving language contact in Europe and Italy makes it increasingly urgent to develop educational models capable of recognising and valuing linguistic diversity as a resource for learning. From this perspective, managing multilingual contexts requires not only an awareness of the cognitive benefits associated with mastering multiple languages, but also careful consideration of the psychological and social implications linked to language acquisition processes. Indeed, various studies have shown that multilingualism can support the development of executive functions, metacognitive skills and theory of mind, as well as fostering the strengthening of empathic skills and interpersonal abilities (Bonifacci et al., 2012). A fundamental aspect of promoting psychological well-being in educational settings characterised by multilingualism concerns the recognition and promotion of pupils' languages of origin from the earliest stages of their schooling. Such a pedagogical approach helps to consolidate a sense of belonging, facilitate integration processes and support the construction of pupils' linguistic and cultural identity (Garcia

and Sanchez, 2018). However, for these positive effects to be fully realised, it is essential to ensure continuous and qualitatively meaningful exposure to languages, as well as to promote educational approaches characterised by inclusivity and the valuing of linguistic diversity.

The paper also explores the relationship between implicit and explicit learning in language acquisition processes and the role of teaching strategies aimed at enhancing individual linguistic repertoires. This context encompasses innovative approaches such as translanguaging (Carbonara and Scibetta, 2020) and the CLIL (Content and Language Integrated Learning) methodology, which propose a dynamic and integrated vision of language education, based on the interaction between the learning of subject content, the development of communicative skills and the creation of inclusive learning environments (Balboni, 2008).

Further attention is devoted to the L'AltRoparlante project, an action-research initiative which, drawing in part on the CUNY-NYSIEB model developed in New York, promotes the structured integration of translanguaging into daily teaching practice through teacher training, shared educational planning and the monitoring of inclusive practices (Carbonara *et al.*, 2020). From this perspective, these approaches serve as pedagogical tools capable of supporting collaborative and inclusive methodologies, contributing not only to the enhancement of linguistic skills but also to the promotion of students' psychological and relational well-being.

Finally, the theoretical considerations presented highlight the need to re-interpret the role of the school as a complex and dynamic linguistic ecosystem, in which multilingualism and educational innovation play a strategic role in building more equitable and inclusive educational contexts. From this perspective, the concept of extended language learning emerges as a pedagogical paradigm capable of integrating cognitive, emotional and social dimensions into the development of language skills, whilst simultaneously fostering both individual and collective well-being.

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THE DUAL CAREER BETWEEN EDUCATION AND SPORT

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1. Introduction

The dual career poses a significant challenge for athletes seeking to balance sporting excellence with academic and professional success; this research examines the issue of the lack of adequate structural and psychological support for student-athletes.

2. Methodology

A quantitative survey was therefore conducted among 173 secondary school student-athletes aged between 15 and 20, who were asked to complete an online questionnaire. The analysis was carried out using data analysis tools: Pandas and Matplotlib for creating graphs and identifying patterns. The results show that 60% perceive balancing study and sport as difficult or very difficult, whilst 75% report significant levels of stress. 60% do not receive or recognise structured academic support, whilst 50% have considered giving up sport to focus on their studies; finally, 75% explicitly request improved support. The study was compared with a dropout survey conducted among students in two different regions.

3. Conclusion

This questionnaire and its findings provide an overview of the phenomenon of early school leaving in Italy, highlighting the differences between the north and south of the country. The key issue lies in the gap between the regulatory framework and the day-to-day reality experienced by student-athletes. In conclusion, only through networking and an integrated approach combining curricular flexibility, mentoring,

accessible assistive technologies, psychological support and teacher training can we build an equitable and sustainable education and sports system for all student-athletes.

Keywords

Dual Career; Education; Sport.

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SERIOUS GAMES AND FUTURE SKILLS IN STUDENTS' SCHOOL GUIDANCE

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The contribution presents a quasi-experimental study investigating the use of Sirius Game to support narrative memory and learning processes in Latin education within lower secondary school, in line with the perspectives of Futures Literacy (Miller, 2018) and the OECD Learning Compass 2030 (OECD, 2019). Sirius Game, developed by Laura Cesaro & Co., is a digital game-based learning environment designed to enhance memory, attention, problem-solving, and reflective skills through immersive and interactive dynamics. By integrating gamification, experiential learning, and emotional engagement, the game promotes active participation, soft skills development, and student-centered learning processes (Garofano et al., 2023; Peconio et al., 2023).

The study involved a sample of 56 students aged between 11 and 16 years and adopted a quasi-experimental design structured into three assessment phases (T0, T1, and T2). A small control group composed of students aged 11–12 years from the initial sample was also included. Narrative memory was assessed through the M6 Narrative Memory Test administered before, during, and after the intervention, while additional questionnaires investigated students' engagement, motivation, perceptions of the game-based learning experience, and reflections on future educational choices.

The intervention was implemented within Latin language activities,

using Sirius Game as a game-based learning environment to support the acquisition and retention of curricular content. Descriptive analyses revealed a progressive improvement in narrative memory performance throughout the intervention. Among students aged 11–12 years, mean scores increased from 1.07 at T0 to 1.18 at T1 and 1.36 at T2, corresponding to an overall increase of 27.1%. Similarly, students aged 13–16 years showed an increase from 0.66 at T0 to 0.82 at T1 and 0.93 at T2, corresponding to a 42.3% increase. These findings suggest a gradual consolidation of narrative recall and learning outcomes across the intervention phases. While younger students achieved higher absolute scores, older students demonstrated the greatest relative improvement over time.

Furthermore, during the T2 phase, 66% of participants reported that the experience positively influenced their reflection on future educational choices. The findings suggest that immersive game-based environments may support narrative memory, engagement, self-determination, and reflective processes connected to educational guidance. Rather than demonstrating direct causal effects on competence development, the results indicate the potential of Serious Games to function as motivational and reflective tools capable of supporting both disciplinary learning and guidance-related processes within inclusive educational contexts.

Although limited by the pilot nature of the study, the relatively small sample size, and the absence of longitudinal follow-up, the findings provide promising evidence regarding the educational value of Serious Games in supporting memory processes, curriculum-based learning, and student reflection. Future research should employ larger samples, longitudinal designs, and inferential statistical analyses to further investigate the contribution of game-based learning environments to academic achievement, educational guidance, and competence development.

Keywords

serious game, educational guidance, playful learning, secondary education, narrative memory

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THE DIGITAL SELF: INTERDISCIPLINARY PATHWAYS AND NON-LINEAR LANGUAGES BETWEEN THEATRICAL PRACTICES AND DIGITAL TECHNOLOGIES

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1. Introduction

Digital technology today represents a pervasive presence in everyday life, profoundly influencing the dynamics of social interaction (Sibilio, 2020; Mazzarella, 2026). Among the many functions that digital technology can assume, a still underexplored dimension concerns its potential as a *medium* through which individuals can deepen their emotional and relational states, thereby strengthening self-knowledge. In current debates, the relationship with technology is often described as one that generates alienation (Friesen, 2017), insofar as “the evolution of new technologies changes not only the style of relationships, but also their content” (Gallese et al., 2025). According to this perspective, “the neuroscientific study of relationships and social practices mediated by digital technology offers a new perspective on intersubjectivity and on the subject in the contemporary trans-aesthetic world” (Gallese et al., 2025). In today’s society, defined by Floridi as *onlife* (Floridi, 2015), digital technology is no longer considered an external element of human experience, but rather a structural component of it, thus requiring a rethinking of the relationship between individuals and technology in dialogical terms. Within this framework, digital technology can be regarded as a support device and an epistemic channel

capable of accompanying cognitive processes and promoting reflective practices (Schön, 1993; Gallese, 2026). The present study aims to explore the use of technologies mediated by human intervention, through the use of non-linear languages (Carlomagno, 2023), in order to activate processes of emotional and relational introspection that support the development of self-awareness.

2. Research

The pilot study adopts the Art-Based Research (ABR) methodology (Leavy, 2015), investigated through the experimental CReAP+T approach, which focuses on the dynamics of Corporeality, Creativity, Relation, Emotion/Empathy, Action, Performativity, and Technology/Training (Carlomagno, 2022). This methodological choice aims to explore the potential of technology as a device capable of activating processes of introspection and fostering greater awareness of emotional and relational states (Gallese & Morelli, 2024). The mixed-method (qualiquantitative) pilot study involved approximately 100 third-year students from the Bachelor's Degree in Education Sciences at the Suor Orsola Benincasa University, who participated in the workshop *Giocando s'impara: tecniche per l'animazione e la comunicazione teatrale*. At the end of the 18-hour course, the level of introspection achieved by the students was assessed through logbooks compiled at the end of each session, and a structured questionnaire based on a 5-point Likert scale, administered at the conclusion of the experience. The data analysis, conducted via a mixed-method approach, integrated the thematic analysis of the logbooks with the descriptive statistics of the questionnaire. The workshop featured an experiential journey structured into six stages, during which students, equipped with smartphones, headphones, a notebook, and a pen, interacted with six boxes containing tactile objects and NFC tags, each associated with a reflective prompt. The experience concluded with the creation of an authentic task, consisting of a collage (paper or digital) aimed at reworking the emerged content, and the design

of an educational intervention intended for the 0-3 age group. Through these activities, students developed design skills and soft skills useful for managing educational contexts through theatrical practices and digital technologies. The findings highlight a strong impact in fostering introspection and awareness through the use of technological mediation. In particular, 84.8% of the sample confirmed that the acoustic isolation of the headphones favored inner attention, even though the space was shared with other classmates ($M=4.34$). For 86.6%, the interaction with the boxes intensified engagement more than a paper reading of the prompts would have done ($M=4.30$). Meanwhile, 84.8% stated that the acoustic isolation provided by the headphones made it possible to perceive the body and the surrounding space in a more conscious way ($M=4.34$). These results suggest that experiential activities integrated with digital tools can foster higher levels of introspection, promoting a use of digital technology oriented in a reflective and educational sense.

3. Conclusions

The results of this pilot study highlight how the integration of theatrical practices and digital technologies, based on an active involvement of the bodily and relational dimension, can foster the activation of emotional introspection processes and contribute to the development of self-awareness (Selwyn, 2021). In this perspective, digital technology does not configure itself as a substitute for human experience, but rather as a device of mediation capable of amplifying and supporting reflective pathways (Schön, 1993; Gallese, 2026; Selwyn, 2021). The proposed model intends to offer an innovative contribution to educational design, showing how it is possible to rethink the use of technologies in a human-centered and inclusive key, enhancing their potential to support formative and transformative processes (Mezirow, 2003) for future education professionals (Boal, 1974). Despite the positive results, the pilot study presents some limitations that open up to future developments in research. The homogeneity of the sam-

ple suggests the need to test the model on more diversified target groups to guarantee its generalizability. Furthermore, it will be necessary to investigate further whether the high engagement detected ($M=4.34$) stems from the effectiveness of the method or from a partial novelty effect linked to the use of NFC tags in the classroom.

Keywords

Trans-disciplinary research trajectories; Performative and stage methodologies; Innovative cybernetic instrumentation.

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INCLUSIVE STORIES IN HIGHER EDUCATION: THE EXPERIENCE OF THE INTEGRATED THEATRE WORKSHOP “CERCHIO TEATRO” AT THE UNIVERSITY OF ROME TOR VERGATA

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Abstract

Universities are called not only to ensure access, but also to provide tools and services that enable students with disabilities to fully achieve academic success (De los Santos et al., 2019; Fernández-Batanero et al., 2022). Research has identified three types of barriers – architectural, methodological, and social – that can hinder their effective participation (Carballo et al., 2021). Social barriers are the most frequently encountered and the most concerning for students with disabilities (Odamé et al., 2021; Martins & Moríña, 2022). In Italy, support for cultural and artistic activities is nearly absent (only one university out of 84), while compensatory and guidance services prevail (15% and 12%) (ANVUR, 2022). Against this backdrop, there is a clear need to expand educational offerings towards the promotion of cultural and artistic practices for students with disabilities. In this context, the University Committee for the Inclusion of Students with Special Educational Needs (CARIS) at the University of Rome Tor Vergata has been organising the Integrated Theatre Laboratory Cerchio Teatro for over ten years. Although the laboratory was temporarily suspended due to lack of funding, its current revival represents an opportunity for artistic education and inclusion, open to students with and without disabilities, as well as academic and administrative staff. This study adopted an exploratory mixed-methods

design with convenience sampling (N=10). A Google Forms questionnaire was used, including several measures: a short version of the Psychological Sense of School Belonging Scale (Goodenow, 1993) adapted to the university context, a five-item scale on personal well-being and transversal skills, and three open-ended questions to explore the experience of the integrated theatre laboratory. Nonparametric descriptive statistics (Md and IQR) and reflexive thematic analysis (Braun & Clarke, 2006) were used. Quantitative results indicate high scores on both the sense of belonging scale (Md=27.0/30, IQR=3) and the wellbeing scale (Md=22.5/25, IQR=3). The most significant items were diversity as a resource and body expressiveness (Md=5.0), while belonging to the university showed greater variability in responses (Md=4.0, IQR=3-4). The thematic analysis identified four main themes: personal growth and increased self-esteem, community and relational bonds, disability as a resource, and inclusive processes as an intrinsic co-design of the workshop. These findings suggest that integrated theater can represent a valuable artistic and inclusive model, fostering a sense of social belonging within the group. However, a gap emerges when compared to the sense of belonging to the university community: for these reasons, the need to implement institutional policies that allow these experiences to be integrated systematically and continuously is highlighted.

Keywords

university, integrated theatre workshop, special educational needs, sense of belonging

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A MULTIMODAL AI-BASED ADAPTIVE LEARNING

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Framework for Neurodiverse Learners with Real-Time Attention Tracking

Abstract

Today’s neurodiverse learner-friendly adaptive learning system provides inclusive access to education for dyslexic individuals, those with Attention Deficit Hyperactivity Disorder (ADHD), and Autism Spectrum Disorder (ASD). The proposed system differs from traditional e-learning systems that use a one-size-fits-all design. The system uses artificial intelligence (AI) to produce individualized learning experiences using large language models (LLMs), neuroadaptive prompt engineering, and real-time behavioural data collected during learning. It generates instructional materials based on each student’s cognitive profile, while keyword-based memory reinforcement ensures longitudinal stability. A Focus AI subsystem moni-

tors student attention and engagement with course material. When attention drops below a threshold, adaptive intervention is triggered. Test data from 2,000 student records and simulation tests show improved individualized content, adaptive responsiveness, and increased engagement. Results demonstrate improved accessibility, scalability, and real-time adaptation of educational services for neurodiverse students.

Keywords

Adaptable Learning, Neurodiversity, Large Language Model, Prompt Engineering, Learning Analytics, Access to Education.

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THE DEBRIEFING PROCESS AND AI: REFLECTION AND REDESIGN TO SUPPORT EDUCATIONAL ACCESSIBILITY

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The introduction of Artificial Intelligence into educational settings is a reality that poses an urgent challenge to the educational community (Fu et al., 2025), prompting it to undertake a critical, multi-level and cross-sectoral re-evaluation of the purpose, scope and conditions of use of these tools (Hardaker & Glenn, 2025). Given the pervasiveness of digital media in the education system, the introduction of AI raises significant issues that are not only epistemological, but also ethical and social (Vinci et al., 2026). Although AI offers opportunities for personalisation, the automation of repetitive tasks and access to diverse educational resources (Traetta et al., 2021), concerns are emerging regarding the delegation of decision-making to algorithmic systems, the potential reduction in the teacher's mediating and planning role, and the risks associated with the opacity of processes (Vinci et al., 2025). Following the 'Human-in-the-loop' paradigm, this study analyses the integration of AI into the debriefing phase of spatial planning, which, by highlighting critical issues in the design process, encourages the planner towards greater awareness, with the aim of improving inclusivity and ensuring educational accessibility (Perla & Vinci, 2024). The study adopts a mixed-methods approach, centred on the administration of a CAWI questionnaire (quantitative and qualitative) and a pre-post research design to a sample of 130 trainee teachers enrolled on the Bachelor's degree programme in Primary Education, who are attending a seminar on General Pedagogy at the University

of Foggia during the 2025–2026. Participants were asked to design a teaching activity for primary school that highlights local heritage – both tangible and intangible – through innovative methodologies. The research has the dual objective of promoting heritage education with a particular focus on inclusion and accessibility, and of experimenting with the use of AI as a tool for assessing the quality of teaching design (Berardi & Paladino, 2025). Data analysis will compare the means of the two groups (Pre vs Post) using independent samples t-tests, verifying the significance of the overall change without linking individual participants. The expected results could be useful for outlining a paradigm for teacher training, in which Artificial Intelligence acts as a multiplier of reflexivity rather than as a mere automatism. Through three specific phases – initial analysis, algorithmic feedback and redesign – AI is reinterpreted as a tool for cognitive mediation capable of supporting processes of analysis, review and informed redesign (Agrati & Beri, 2025). This research explores how to improve accessibility and inclusion through AI-mediated processes that support critical analysis and design review. More specifically, by querying chatbots with specific prompts, algorithmic debriefing helped designers identify customisation variables that were initially implicit. The question arises as to whether critical interaction with prompts can transform the perception of AI from a potential threat to a teaching tool into a support tool. It is hypothesised that interaction with AI may enable participants to identify and break down architectural and cognitive barriers previously underestimated in territorial activities. Ultimately, the AI-mediated cycle of redesign and meta-evaluation not only optimises educational resources relating to the local area, but also fosters a critical and informed mindset (Vinci & Berardi, 2025) in future teachers, enabling them to navigate the opacity of algorithms and harness them in the service of an equitable, personalised and accessible school system.

Keywords

The debriefing process and AI; Instructional design; Inclusion; Accessibility.

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ADAPTIVE LEARNING TECHNOLOGIES AND PERSONALISED EDUCATION: CAN AI STOP THE ACHIEVEMENT GAPS? A SYSTEMATIC REVIEW

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1. Abstract Background

Educational achievement gaps rooted in socio-economic inequality remain among the most persistent structural challenges in global education. The surge in the Artificial Intelligence (AI) powered adaptive learning technologies has captured the attention of scholars and policy makers, particularly regarding their potential to deliver equitable, personalised learning experiences, particularly for the marginalized and deprived youth. However, a consolidated, critically evaluated evidence-based examination of whether these technologies genuinely reduce achievement disparities or inadvertently reinforce them through algorithmic bias and unequal access remains limited.

2. Objective

This systematic literature review includes empirical, conceptual and policy-oriented evidence from journals to critically evaluate the effectiveness of AI-enabled adaptive learning technologies in reducing educational achievement gaps to identify the structural conditions under which such technologies promote or hinder educational equity.

3. Methodology

This paper follows PRISMA 2020 reporting guidelines, systematic search was conducted across academic databases, the Scopus. The publication

period of included articles is from 2020 to 2025. Documents were search by using keywords in combination of 'adaptive learning and academic achievement', 'personalised learning and academic achievement', and 'personalised learning and adaptive learning and academic achievement'. A total of 887 published documents were initially identified based on the search performed, after applying language filter i.e., language as English, total of 865 documents was available for screening. From which 196 duplicate documents were removed. After title and abstract screening (n=669), 135 full-text articles were assessed for inclusion. Studies were excluded if they were thematically off-topic (n=534). For inclusion of the studies in this systematic review the criteria were; the studies showing their relevance in answering the research question and show relation between academic achievement, adaptive learning and personalised learning. A final of 54 peer reviewed studies met all inclusion criteria. Mixed-Method Appraisal Tool (MMAT) was used for quality check and reducing biasness of included studies.

4. Results

The 54 studies were thematically analysed under the following four heads:

1. **Measurable Cognitive and Learning Gains:** Multiple meta-analyses and empirical studies reported medium-to-large positive effect sizes for AI adaptive platforms on students learning outcomes, with evidence suggesting particular benefit for learners from low-income group and marginalized backwards when access conditions are met.
2. **Persistent Structural Barriers:** Despite promising outcomes, studies consistently identified the digital divide, socio-economic access gaps, and algorithmic bias as significant moderators that limit or reverse the equity enhancing potential of adaptive technologies, disproportionately affecting rural, low-SES, and racially minoritized student populations.
3. **Pedagogical Misalignment:** Several critical analyses highlight a fundamental tension between AI-driven personalization which optimizes for measurable domain knowledge and broader 21st -cen-

tury educational goals encompassing student agency, self-regulated learning, creativity, and social competency development.

- 4. Policy and Institutional Prerequisites:** Evidence across multiple studies pointed to the necessity of national and institutional policy frameworks, equity by design principles, teacher mediation, and infrastructural investment as preconditions for adaptive technologies to achieve equitable impact at scale.

5. Conclusion

AI-powered adaptive learning technologies demonstrate meaningful potential to reduce educational achievement gaps; their effectiveness is significantly moderated by socioeconomic access, algorithmic fairness, platform design quality, and the availability of institutional support structures. The evidence suggests that without deliberate equity-centred design and inclusive policy intervention, these technologies risk amplifying rather than alleviating existing disparities. Future research should prioritize longitudinal studies across diverse geographic and demographic contexts, with particular attention to underserved and rural youth populations in the Global South.

Keywords

Adaptive Learning Technologies, Artificial Intelligence in Education, Achievement Gap, Educational Equity, Personalized Learning, Digital Divide, SocioEconomic Inequality.

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TRAINING RHAPSODES IN THE 21ST CENTURY: DIGITAL STORYTELLING FOR THE INCLUSIVE TEACHING OF CLASSICAL LITERATURE

Marco di Furia

Abstract

Humanity has been producing narratives since the dawn of time. Beyond assigning meaning to the data of reality – as Bruner demonstrated in his landmark studies (1986) – contemporary narrative serves primarily to construct the informational and educational frameworks upon which collective values are built, particularly through a multimodal lens (Kress, 2010). Indeed, the act of *storytelling* is often synonymous with the act of *teaching*. If storytelling is a fundamental skill, the central pedagogical question must address universal access to this art form. For educators, the daily imperative is to ensure that these informational structures are accessible to everyone, thereby guaranteeing an equitable cultural heritage for all students. In this paper, the author presents an experimental teaching module based on a technology-driven strategy: Digital Storytelling (DST). This practice, which originated in the United States (Lambert, 2013), has been extensively tested in global educational contexts (Wu & Chen, 2020). This study adopts a qualitative action-research methodology, conducted in the field through the administration of a questionnaire to a sample of 46 lower secondary school students, including 7 students with Specific Learning Disorders (SLD) and one student with Special Educational Needs (SEN). The study follows a longitudinal descriptive approach and involved a two-stage administration of the same questionnaire to evaluate the impact of computer-based tasks on students. The focus was specifically placed on accessibility to the literary discipline, the level of comprehension of complex texts, and perceptions

of self-efficacy regarding communicative and linguistic-literary skills. The intervention, which spanned six weeks, utilized Canva software for the creation of digital storyboards. The effectiveness of the intervention was measured through a mixed-methods approach: a questionnaire featuring open-ended questions, Likert scales for the evaluation of student feedback, and an assessment rubric for the produced multimedia outputs. The results indicate that the computer-based approach and the Digital Storytelling (DST) methodology made the comprehension and re-elaboration of classical texts more accessible, enabling the development of personal narratives, elaborated through images and supported by sources. The study is not without limitations, given the small sample size and the current lack of quantitative instruments, which could be integrated into future iterations of the research design.

Keywords

Literacy, Storytelling, Methodologies of Teaching, Storyboard, Special Education.

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BETWEEN TECHNICAL SCAFFOLDING AND PROFESSIONAL MIRRORING: INTEGRATING AI AND PEER FEEDBACK IN FORMATIVE ASSESSMENT

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The transition toward Assessment as Learning practices is structurally re-defining the role of evaluation in education. It is no longer viewed merely as a summative measurement but as a vehicle for self-regulation, aimed at fostering talent and developing core competencies (Lan & Zhou, 2025; Van Orman et al., 2024; Agrati et al., 2025). Within this framework, it is crucial for pre-service teachers to develop Teacher Design Self-Efficacy: the self-belief and agency required to autonomously orchestrate and design inclusive, technologically advanced learning environments (Vinci et al., 2026).

Formative feedback serves as the primary driver for constructing this self-efficacy. While peer feedback promotes critical reflection and collaboration (Buckingham Shum et al., 2023; Ortega-Ruipérez & Correa-Gorospe, 2024), its application among novice teachers often suffers from an expertise gap, which can constrain pedagogical innovation and pragmatic utility (Parmigiani et al., 2025; Tasmin et al., 2025). Generative Artificial Intelligence addresses this gap not as a mere automated grader, but as a co-designer and an expert scaffolding tool capable of mitigating the technical vulnerabilities inherent in human-only assessment (Lee & Moore, 2024; Topping et al., 2025; Alghamdi & Alghizzi, 2025; Guardia-Paniura et al., 2026).

Drawing upon this theoretical underpinning, the present study explores two core research questions:

RQ1: Is there a statistically significant difference in the perceived utility of AI-generated feedback compared to peer feedback?

RQ2: To what extent does the integration of these two evaluative sources (and their presumed complementarity) predict the development of Teacher Design Self-Efficacy?

The analysis, conducted with 119 pre-service teachers engaged in designing a Learning Unit (i.e., a comprehensive instructional sequence comprising specific learning objectives, pedagogical goals, content, and methodologies), offers a novel perspective on the synergy between human and artificial intelligence.

Variables were operationalized via a 10-point Likert scale measuring multi-item constructs. Participants interacted with locally deployed Large Language Models (LLMs) using standardized prompting protocols designed by the researchers to secure targeted formative feedback. In response to RQ1, results from a paired-samples t-test indicated that AI-generated feedback was rated statistically significantly higher in perceived utility ($M = 7.85$) than peer-provided feedback ($M = 7.45$), $t(118) = 2.93$, $p = .004$. This finding suggests that AI functions as an expert system capable of providing more precise and immediate technical scaffolding, thereby bridging the "expertise gap" typical of novice teachers who often struggle to offer analytical or innovative suggestions.

However, the Structural Equation Modelling (SEM) used to investigate the second research question (RQ2) reveals a deeper and more nuanced dynamic.

Although AI is perceived as technically superior, the model yielded an acceptable data fit despite the compact sample size ($CFI = .878$, $TLI = .837$, $RMSEA = .166$, $SRMR = .177$), with the structural pathways significantly predicting teacher design self-efficacy and collectively explaining 27.3% of the total variance. In this context, peer feedback emerges as the most influential predictor of a future teacher's professional confidence ($\beta = .33$, $p = .002$), surpassing the contribution, albeit fundamen-

tal, of AI ($\beta = .27$, $p = .009$). This discrepancy indicates that while AI provides the technical foundations necessary to refine the instructional product, human interaction serves as a “professional mirror”, validating the teacher’s identity and consolidating their operational confidence in a way that machines cannot replicate.

A further point of reflection arises from the lack of statistical significance regarding the construct of perceived complementarity ($\beta = .02$, $p = .805$). This result is theoretically meaningful: it demonstrates that the core evaluative synergy does not depend on students’ abstract, ideological convictions about technology, but operates on a pragmatic, functional level where AI enables technical correctness while peers validate professional identity.

Ultimately, the adoption of AI in teacher education does not aim to replace human interaction; rather, it inaugurates an assessment as learning model where technology enhances design autonomy, preparing educators to navigate the challenges of contemporary inclusive pedagogy with heightened awareness. Please note that the first paragraph of a section or subsection is not indented. The first paragraphs that follows a table, figure, equation etc. does not have an indent, either.

Keywords

Formative Assessment, AI Feedback, Peer Feedback, Pre-service Teachers, GenAI

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DOCTORAL NEWSROOMS AS COMMUNICATIVE LEARNING ENVIRONMENTS: COLLECTIVE AI LITERACY AND REFLECTIVE PRACTICE IN LESDIT

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Abstract

Digital transformation has redefined communication practices and collaboration dynamics in professional and educational contexts, making the production and sharing of contents an integral part of learning processes. In this scenario, doctoral training increasingly requires not only the ability to produce knowledge, but also to communicate it to broader audiences, developing a critical and informed relationship with the emerging technologies that mediate this communication today. Despite growing attention to research dissemination in doctoral education, little has been explored regarding whether and how collaborative editorial practices can themselves become spaces of learning, communicative empowerment, and critical literacy toward technology, in our study, toward generative artificial intelligence. This contribution analyzes the experience of LESDIT NEWSROOM, the newsroom of the national doctoral programme in Learning Sciences and Digital Technologies, composed of doctoral students from different universities, disciplinary backgrounds, and professional contexts, asking how participation in

a transdisciplinary doctoral newsroom fosters professional reflexivity and transformation of research mediation practices among participants with heterogeneous backgrounds. The paper adopts a qualitative case study approach with an insider research design, combining documentary analysis of editorial outputs, collaborative reflection, (Schön, 1983) and semi-structured interviews with participants ($n=7/8$). The sample, while intentionally small in line with the principle of information power in qualitative research (Malterud et al., 2015), reflects significant internal diversity across generational cohorts (ages 26– 65) and disciplinary backgrounds (including artistic, scientific, journalistic, literary, organizational, psychological, and management studies), which mitigates the risks of bias inherent in insider research. Data were analyzed through thematic analysis following Braun and Clarke's (2006) six-phase model, and triangulated across the three data sources to ensure validity and reliability. The study draws on the theoretical frameworks of communities of practice (Wenger, 1998), boundary crossing (Akkerman & Bakker, 2011), and connected learning (Ito et al., 2013).

Preliminary findings suggest that shared editorial practice produces two orders of effects. The first concerns interdisciplinary cross-pollination: participants develop new perspectives and transferable skills without losing their disciplinary specificity, a particularly relevant aspect when the object of communication, artificial intelligence, is by its very nature transversal to all fields of research. The second concerns communicative agency: through editorial practice and conscious reflection on it, participants develop a growing capacity to mediate their research to broader audiences, transforming their positioning with respect to science communication and the relationship with non-specialist publics. LESDIT NEWSROOM is proposed as a useful case for rethinking doctoral education in a collaborative and technologically aware direction, offering implications for the design of educational and professional environments in which digital communication becomes a

space of empowerment, reflective development, and critical negotiation with emerging technologies.

Keywords

Doctoral education; science communication; AI literacy; situated learning; communities of practice

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FROM UNIVERSITY TRAINING TO SCHOOL PRACTICE: GAME-BASED LEARNING AND DIGITAL STORYTELLING IN HISTORY EDUCATION

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Abstract

This study presents an exploratory empirical investigation aimed at examining the transferability of Game-Based Learning (GBL) and digital storytelling from university training to school practice. Pre-service primary education teachers participated in a digital instructional design workshop, where they developed a gamified learning unit on Ancient Egyptian civilization, subsequently implemented during their teaching practicum in primary school. Data collected through structured questionnaires show positive outcomes in both contexts: university students developed transferable design and methodological competences, while pupils involved in GBL and digital storytelling activities reported higher levels of motivation, engagement, and understanding compared to those exposed to traditional teaching. The results confirm the effectiveness of GBL in history education and highlight the value of university laboratories as experiential learning environments (Perla, 2010; Agrati, 2017; Perla & Vinci, 2022).

Keywords

Game-Based Learning – Digital Storytelling – Teacher Education – History Education – Experiential Learning

1. Introduction

Contemporary pedagogical reflection calls for a profound rethinking of teaching practices, encouraging the shift from transmissive and lecture-based models toward active, participatory, and competence-oriented approaches (Perla & Vinci, 2022). In this context, the integration of digital technologies in education represents not only a technological update but also an opportunity to redesign teaching and learning processes, particularly in primary education. Among the methodologies that best support this transformation, Game-Based Learning (GBL) and digital storytelling play a prominent role in international educational research. GBL is grounded in the principle of learning by doing: through play, learners engage in decision-making, problem-solving, and reflective processes within meaningful contexts (Dettori & Letteri, 2021; Gabbi et al., 2023). The educational value of play is widely recognized across disciplines, including anthropology (Huizinga, 1938), sociology (Caillois, 1967), developmental psychology (Piaget, 1955), and pragmatist pedagogy (Dewey, 1938). This interdisciplinary foundation provides strong theoretical support for the adoption of GBL in teacher education contexts (Massaro et al., 2023). Digital storytelling is a narrative practice mediated by digital technologies that fosters deep cognitive and emotional processes, supporting knowledge construction through storytelling (Mariotti & Marotta, 2020). When integrated with GBL, it transforms history into an engaging and meaningful learning experience (Zannini, 2021). In this perspective, initial teacher education plays a strategic role. During university training, future teachers can acquire both theoretical knowledge and practical competences. This study investigates the conditions and outcomes of such transferability.

2. Methodology

2.1. Research Design

The study adopts an exploratory empirical approach with a predominantly quantitative orientation (Trinchero, 2012), structured in two

complementary phases. In the second phase, the research follows a quasi-experimental design comparing an experimental group with a control group.

2.2. University Laboratory

The first phase involved students enrolled in the Primary Education degree program at the University of Bari Aldo Moro (N = 200). Within a dedicated laboratory, students explored the theoretical foundations of GBL and digital storytelling and developed competences using digital tools such as Book Creator, LearningApps, Wordwall, Genially, and PanQuiz. Activities included the design of micro learning units, fostering instructional design competences. A subgroup designed a structured unit on Ancient Egyptian civilization, integrating digital game-based activities and narrative sequences.

2.3. School Implementation

In the second phase, the learning unit was implemented during teaching practicum in two primary school classes (N = 40). The classes were divided into an experimental group and a control group. Data were collected through structured questionnaires administered in CAWI mode before and after the intervention. The motivation construct was measured using a 5-point Likert scale questionnaire adapted from the Intrinsic Motivation Inventory (IMI) (Ryan & Deci, 2000), comprising items addressing interest/enjoyment, perceived competence, and effort. Engagement was assessed through teacher observation grids and student self-report items. Perceived understanding was measured via a 5-item self-assessment scale. Questionnaires in the primary school setting were administered by external evaluators, independent from the pre-service teachers conducting the intervention, in order to minimize social desirability bias. Data were analyzed using both descriptive statistics and inferential statistics (Trinchero, 2012): group differences (experimen-

tal vs. control) were tested using the Mann-Whitney U test, given the non-parametric distribution of the sample, and effect sizes were calculated using Cohen's *d* to assess the practical significance of the observed differences.

3. Results and Discussion

3.1 School Context

Pupils involved in GBL and digital storytelling reported higher levels of intrinsic motivation, engagement, and perceived understanding compared to those receiving traditional instruction. Improved retention and a positive evaluation of the learning experience were also observed. These findings align with previous studies highlighting the effectiveness of GBL in fostering problem-solving, collaboration, and metacognitive reflection (Wiggins, 2016; Gabbi et al., 2023). Digital storytelling enhanced the understanding of temporal and causal relationships (Mariotti & Marotta, 2020; Zannini, 2021).

3.2 University Context

University students demonstrated active engagement and reported acquiring both technological and instructional design competences. The micro-design experience supported reflective practice and confirmed the effectiveness of laboratory-based learning (Perla, 2010; Agrati, 2017).

3.3 Transferability and Implications

Results suggest that competences acquired in university settings can be effectively transferred to school practice. Teaching practicum plays a crucial role in this process. These findings highlight the importance of integrating active methodologies and experiential learning into teacher education curricula.

4. Conclusion

This study explored the potential of Game-Based Learning and digital storytelling as innovative teaching methodologies and examined their transferability from university training to school practice. Despite the exploratory nature of the study, results indicate positive effects on student motivation and learning, as well as the effectiveness of university laboratories in developing instructional competences. Future research should involve larger samples and mixed-method approaches to further validate these findings. Several limitations must be acknowledged. The school-level sample ($N = 40$) limits the statistical power and generalizability of the results. The reliance on self-report measures introduces potential subjectivity, and the short duration of the intervention may not capture sustained learning effects. Although inferential analyses were conducted, replication with larger, more diverse samples is needed before drawing broader conclusions about the effectiveness of GBL and digital storytelling in history education. Notwithstanding these constraints, the study offers a replicable model of university laboratory-based instructional design with transferable pedagogical value.

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TECHNOLOGIES FOR INCLUSION: A PLAYFUL-MOTOR INTERVENTION

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Abstract

This study, framed within the theoretical context of Universal Design for Learning (UDL) and technology-mediated inclusive education models, investigated the effectiveness of a play-based motor intervention centered on the game of bocce, integrated with technological supports, in promoting social interaction, inclusion, and motor coordination in primary school settings. The research involved 56 fifth-grade pupils, including 12 students (21,4%) with Special Educational Needs (SEN), equally distributed between an experimental group ($n = 28$, 6 SEN) and a control group ($n = 28$, 6 SEN). The intervention lasted six months, with two one-hour sessions per week. The Matson Social Skills Scale (MSSS), observational grids, and a motor throwing test were employed. Quantitative data were analyzed using paired and independent t-tests, while qualitative observations were conducted longitudinally, with inter-rater reliability assessed using Cohen's $\kappa = 0.82$. The results indicate significant improvements in the experimental group compared to the control group in social skills (MSSS: $t(54) = 4.21$, $p < .001$) and motor coordination ($t(54) = 3.88$, $p < .001$). Observational findings further confirm increased peer cooperation and greater engagement among students with SEN. Although it cannot be excluded that part of the improvements observed was also influenced by the novelty effect linked to the use of technological supports (Hawthorne effect), the results suggest that the integration between recreational-mo-

tor activities and assistive technologies may represent an effective strategy to promote inclusive educational contexts in primary school.

Keywords

Inclusion; Technologies; Playful-motor interventions; Special Educational Needs

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CRITICAL CO-AGENCY: THE ETHICS OF AI AS COGNITIVE EMPOWERMENT IN PROFESSIONAL AND EDUCATIONAL CONTEXTS

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Author keywords: AI ethics, cognitive empowerment, AI literacy, metacognition, generative artificial intelligence

Abstract

Recent empirical research on the ethics of artificial intelligence in professional and educational contexts suggests that ethical engagement with AI systems, far from being limited to risk prevention and regulatory compliance, produces in those who work, study and train with them a measurable development of cognitive skills that passive or uncritical use does not generate.

This paper addresses the question through a theoretical synthesis of empirical studies (2024–2025) on the relationship between ethical-critical engagement with AI and cognitive growth in educational and professional contexts.

The results show significant convergence. Yang, Xie and Ni (2025) identify a causal pathway from ethical knowledge of AI to operational ethical skills, and from these to enhanced learning capacity. Gonsalves (2024) documents cognitive skills generated specifically by the critical interrogation of AI outputs. Two quasi-experimental studies (Xu et al., 2025; Zhai & Nezakatgoo, 2025) find that metacognitive support during interaction with generative AI enhances self-regulated learning, while its absence produces a decline in these same abilities. Adeogun et al. (2025) replicated these findings in Ghana and Nigeria. The most recent

AI literacy frameworks (Chee et al., 2025; Tadimalla & Maher, 2025) propose models in which the ethical dimension underlies higher-order cognitive skills and constitutes a prerequisite for their development.

These findings have not been adequately theorised. Passive, delegating use of AI impoverishes the cognitive capacities it should serve: judgement, evaluation, interpretation weaken when they are systematically outsourced. Sen (1999) and Nussbaum (2011) give this problem a precise philosophical name.

The capacity for critical thought, practical reasoning and control over one's working environment are among the conditions for a dignified life, and any organisation that introduces AI into its processes bears responsibility for their preservation. An ethics of AI that ignores this is incomplete. This paper develops the argument through the construct of "critical co-agency", which designates the disposition to collaborate with intelligent systems whilst maintaining the cognitive autonomy necessary to question their outputs, recognise their structural limitations, and exercise situated judgement where algorithmic reasoning proves insufficient. Five areas give the construct operational form: the quality of human-AI interaction in working and learning processes; the diffusion of critical awareness regarding the tools in use; the learning effectively produced by the introduction of AI; the evolution of individual competences over time; the creative integration of AI into cognitive and decision-making processes.

The evidence examined suggests that developing this disposition is in itself an act of cognitive empowerment, and therefore a fully-fledged ethical issue, one that opens the concrete possibility of redesigning professional and educational training around a redefinition of the ethical field.

The studies reviewed draw almost exclusively on university samples, the research designs are heterogeneous, and whether critical co-agency holds in professional contexts outside academia remains to be tested.

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REFLECTIONS, SUPPORTED BY DATA AND EXPERIENCES, AROUND THE IMPACT OF TECHNOLOGIES ON LEARNING AND HOLISTIC DEVELOPMENT OF CHILDREN

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Author keywords:

Computer and information literacy

Civic participation

Artificial intelligence

Social and internet usage

Abstract

Nowadays technologies are around, smartphones have spread and become the medium for accessing all everyday activities from learning to working and social engagement too. Apps supported by Artificial Intelligence are changing the way we teach, learn and socialize. Meanwhile results on international worldwide surveys are exposing results with decreasing quality in reading, mathematics and science exposing a steady decline. Data on psychological and special education needs are increasing especially for childhood, i.e., people aged from 0 to 19 years. The work will present the authors' opinion supported by their reading on data from international surveys. I.e. PISA, ICILS, ICCS and the associated reports, and open datasets on learning and psychology to share their insight on the following open questions: which is the impact of technologies on learning of children? If and how technologies could support holistic development? What could be the right timing and approach to expose to trending and fast changing apps from social media to artificial intelligence. Guidelines and best practices distilled from several decades of experiences of the authors as teachers, formal, non-formal and infor-

mal educators, researchers and social activists will be shared for an open discussion. Potential list of surveys:

Programme for International Student Assessment, International Civic and Citizenship Education Study, International Computer and Information Literacy Study, Trends in International Mathematics and Science Study, Teaching and Learning International Survey, International demographic surveys, European School Survey Project on Alcohol and Other Drugs.

PERSONALIZED LEARNING, SELF-REGULATION AND EDUCATIONAL EQUITY: AN ADEQUACY PERSPECTIVE IN THE DIGITAL ERA

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Learning is increasingly understood as a highly individual process shaped by the interaction of students' cognitive, motivational, and socio-emotional characteristics. Within this framework, personalized learning aims to adapt content, timing, and instructional strategies to learners' specific needs. Studies have shown that instructional adaptation can improve learning outcomes and increase student engagement and perceived relevance of learning (Pane et al., 2017; Walkington & Bernacki, 2014). At the same time, the expansion of digital educational technologies has transformed the possibilities for personalization through adaptive systems, digital textbooks, and data driven learning environments. Nevertheless, the relationship between personalized learning and educational equity remains controversial, particularly because personalized pathways may produce unequal outcomes among students.

This contribution aims to analyze how personalized learning can contribute to educational equity in the digital era by questioning traditional conceptions of equality based on equal inputs and equal outcomes. Specifically, the paper proposes the “adequacy perspective” as a conceptual framework capable of reconciling differentiated educational support with equitable learning opportunities. This theoretical contribution is based on a critical review of the literature on personalized learning, self-regulation, educational technologies, and educational equity, with

the aim of proposing the adequacy framework as an integrative reference model. Through a conceptual analysis of recent studies, the paper examines how digital learning environments influence learning opportunities differently depending on students' prior knowledge, self-regulation skills, and access to educational resources. Recent research suggests that personalized learning does not automatically generate equitable outcomes. Molenaar (2022) argues that students with stronger self regulation abilities and higher prior knowledge often benefit more from personalized digital learning environments, potentially increasing achievement gaps. In the digital era, educational technologies therefore represent both an opportunity and a challenge for educational equity. Self-regulated learning becomes particularly important in technology-enhanced educational contexts. Effective participation in personalized digital learning environments requires students not only to memorize information, but also to actively engage with learning materials, critically evaluate content, and construct meaningful understanding. In this regard, digital textbooks and interactive educational technologies can support active learning processes by integrating adaptive feedback, multimodal resources, and opportunities for reflection and autonomous learning (Galustyan et al., 2018). From the perspective of educational equity, these dynamics challenge traditional assumptions based on equality of treatment. Providing identical resources to all students does not necessarily ensure equal learning opportunities. On the contrary, differentiated allocation of educational resources may be necessary to support learners with diverse backgrounds and needs (Bradley & Corwyn, 2002). The adequacy perspective therefore suggests that inequalities in inputs may be justified when they enable all students to achieve a minimum threshold of essential competencies, even if differences in final outcomes remain. The original contribution of this paper lies in linking the adequacy perspective with debates on personalized learning and digital self-regulation. While existing literature often examines per-

sonalization mainly in terms of effectiveness or technological innovation, this contribution reframes it as an equity-oriented model grounded in differentiated educational support and adequate learning conditions within digitally mediated environments. The adequacy perspective offers a viable framework for interpreting educational equity in the digital era. Rather than pursuing strict equality of inputs or identical outcomes, it emphasizes the importance of guaranteeing all students access to adequate learning opportunities through personalized and differentiated support. Within digital learning environments, this approach highlights the need to design educational technologies and instructional strategies that account for differences in students' self-regulation capacities and learning conditions. Future research may further investigate how adequacy-oriented models can inform educational policy and the implementation of equitable personalized learning systems.

Keywords

personalized learning; educational equity; self-regulated learning

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NON-COGNITIVE SKILLS AND ANTI-BULLYING STRATEGIES IN EUROPEAN SCHOOLS: A COMPARATIVE EDUCATIONAL PERSPECTIVE

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In recent years, educational policies at both national and European levels have increasingly emphasized the strategic role of non-cognitive skills in fostering inclusive and equitable learning environments. These competencies, commonly defined as social, emotional, and transversal skills, include empathy, emotional regulation, resilience, motivation, and interpersonal abilities. The growing importance of these competencies reflects a shift beyond strictly cognitive models toward educational approaches that recognize the complexity of human development. Within this perspective, schools are expected not only to transmit knowledge, but also to support students' relational, emotional, and social growth. This approach is particularly relevant in addressing bullying, which remains widespread across European school systems. Research indicates that limited non-cognitive skills, such as low empathy or poor self-regulation, are associated with aggressive and exclusionary behaviors. Consequently, educational responses should move beyond reactive and disciplinary approaches, adopting preventive and systemic strategies aimed at strengthening students' socio-emotional competencies.

This study explores the role of non-cognitive skills in the prevention and management of bullying within European school systems through a comparative perspective integrating theoretical and empirical dimensions. The research examines key frameworks related to Social and Emotional Learning (SEL), inclusive pedagogy, and socio-affective edu-

cation, while analyzing how these competencies are implemented across different national contexts and their impact on anti-bullying practices. Methodologically, the study adopts an observational and comparative design involving six European countries (Italy, France, Spain, United Kingdom, Greece, and Germany). The final survey sample consisted of $N = 600$ participants recruited through voluntary participation from six upper secondary schools. Data were collected using a mixed-methods approach. Structured questionnaires investigated socio-emotional practices, awareness of non-cognitive competencies, and bullying management strategies. Non-cognitive skills were assessed through the Social Emotional Competence Questionnaire (SECQ; $\alpha = .88$), while school climate perceptions were measured using the School Climate Bullying Survey (SCBS; $\alpha = .91$). Semi-structured interviews were also conducted to explore perceptions and contextual factors.

The findings reveal increasing attention to non-cognitive skills across European systems, although differences persist in terms of implementation. Schools implementing structured SEL programs reported approximately 28% lower frequencies of bullying episodes and higher levels of perceived relational well-being ($M = 4.1$) compared to contexts with less formalized interventions ($M = 3.2$). Positive correlations also emerged between emotional regulation and school climate indicators ($r = .46$, $p < .01$). Practices such as cooperative learning, peer education, and structured emotional education appeared particularly effective in promoting positive relational dynamics and reducing aggressive behaviors. Teacher training also emerged as a key factor, especially in contexts where teachers participated in structured pathways focused on SEL, cooperative learning, and conflict mediation.

Conclusion

In conclusion, non-cognitive skills represent a crucial dimension for promoting inclusive educational environments and preventing bullying. Their

systematic integration within school systems can support the development of responsible, resilient, and socially engaged individuals.

Keywords

Special Pedagogy; Education; Educational strategies.

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BIG DATA AND CRITICAL MINDS

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1. First Section

1.1 Introduction

This contribution extends prior research on statistics as a tool for critical citizenship by shifting the focus from instructors to students. In the current “Big Data era”, the massive abundance of information has made statistical literacy a fundamental competency for informed citizenship and a necessary shield against informational biases. The ability to interpret graphs, understand probabilities, and critically evaluate quantitative information is essential not only for academic achievement but also for informed decision-making in everyday life.

Within this context, statistical education plays a pivotal role in supporting students’ cognitive development and their ability to engage with complex information environments. This competency extends far beyond mere mathematical computation; it represents an essential response to the challenges of contemporary society, where data-driven narratives often overwhelm individual critical reasoning. As statistical literacy among students is often found to be deficient and uneven, a systematic preliminary assessment is necessary to identify actual educational needs and improve the efficacy of instructional processes. This study is situated within the field of Educational Psychology, examin-

ing how learning experiences, attitudes, and participation in structured STEM activities influence the development of competencies. From a psychopedagogical perspective, statistical learning is shaped not only by formal instruction but also by motivational factors and self-efficacy, providing students with the analytical tools needed to navigate the complexity of the modern data landscape.

1.2 Case study: the "P. Hensemberger" Technical-Industrial Institute in Monza

The study is being piloted at the "P. Hensemberger" Technical-Industrial Institute, a setting strategically chosen for its strong technological orientation and "learning-by-doing" culture. By focusing on a single, homogeneous environment, the research minimizes confounding variables to precisely isolate the impact of STEM activities on cognitive and meta-reflective development. Conceived as an empirical case study, the project aims for analytical generalization rather than immediate statistical projection. Crucially, the pilot institute serves as a laboratory to generate robust theoretical hypotheses and interpretative models intended to be verified in future large-scale studies, providing a scientific foundation for transferable best practices in data literacy. However, a critical limitation of this research is the sample bias associated with the institute's specialized nature. To address this, the protocol is designed to be scalable: the monitoring phase specifically aims to isolate logical-conceptual processes from the high-tech tools available, ensuring that the pedagogical model remains effective and replicable in non-STEM or socially heterogeneous contexts.

2. Second Section

2.1 Methodology

From an operational standpoint, the research adopts a data-driven and longitudinal approach. An initial diagnostic assessment maps baseline probabilistic competencies and prior exposure to laboratory projects. This preliminary phase, conducted on a sample of 400 students, is crucial to

anchor the intervention to real educational needs. Initial data reveals a significant “competence gap”: while students possess high technical proficiency in reading graphs (96%) and bar charts (94%), they struggle with conditional probability (39%) and data-context integration. Furthermore, a strong perceptual bias exists: 66% of students identify STEM exclusively with mathematics, while only 2% recognize its scientific dimension. Despite this, a positive “functional value” is observed, with 67% of the sample considering statistics a useful tool for real-world fields such as healthcare (48%) and economics (38%).

CROSS REFERENCE LEVEL Table 1. Analytical Framework and Cross- Reference Levels. VARIABLES INVOLVED ANALYTICAL OBJECTIVE Profiling <i>Initial Test Results + STEM Participation</i>	Evolutionary <i>Diagnostic Test (Pre) vs. Final Test (Post)</i> External Validity <i>Internal Results + INVALSI Tests</i> Verify if those who have already attended STEM labs start with a stronger statistical foundation. Measure the “educational gain” attributable exclusively to the activities carried out during the year. Confirm if the skills developed in the project are also reflected in national standardized tests.
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To address these gaps and expand the perception of STEM beyond mere formulas, students engage in structured problem-solving activities. These are followed by a summative evaluation to measure shifts in technical skills, self-efficacy, and interest in quantitative disciplines. These shifts are measured using validated psychometric tools adapted from the MSLQ (Pintrich) and PISA frameworks, ensuring that the de-

velopment of an “analytical mindset” is captured through scientifically recognized indicators.

The analytical framework is further enriched by integrating school administrative data (final grades) and INVALSI standardized test scores, enabling the long term monitoring of active pedagogy’s efficacy. Data is cross-referenced through an analysis matrix that correlates objective performance with subjective factors. This allows for an understanding of not only if a student has attained competence, but the underlying mechanisms of why.

TABLE 2 – *STEM Project Evaluation Framework and KPI Matrix.*

DIMENSION	SUCCESS INDICATOR (KPI)
EXPECTED TRANSFORMATION	
Technical	<i>Pre-Post Test Delta</i> Measurable increase in statistical and probabilistic skills.
Systemic	<i>Cross-curricular grades</i> Positive impact of the STEM method on overall academic performance.
Analytical	<i>Generalization</i> Transition from abstract formulas to real-world investigation tools.

The monitoring process is currently ongoing and will conclude at the end of the school year. The final dataset, which will compare these baseline figures with year-end performance, will be integrated into the contribution in time for the conference presentation.

3. Conclusion

This research aims to demonstrate how an integrated approach transforms isolated metrics into a comprehensive narrative of educational success. The project defines achievement through “analytical general-

ization": the shift from perceiving statistics as abstract formulas to using them as real-world investigative tools. The intervention's long-term goals include bridging the gap between theory and scientific practice, validating an exportable educational protocol based on both objective data and student self-efficacy, and fostering a scientific mindset. Ultimately, success is measured not just by academic grades, but by the development of critical citizens capable of navigating societal complexity through the rigor of the statistical method.

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