A DESIGN PATH IN THE SECONDARY SCHOOL THROUGH A UNIVERSAL DESIGN FOR LEARNING, ARTIFICIAL INTELLIGENCE, NEUROSCIENCE AND PRIVACY

UN PERCORSO PROGETTUALE NELLA SCUOLA SECONDARIA DI SECONDO GRADO ATTRAVERSO L'UNIVERSAL DESIGN FOR LEARNING, INTELLIGENZA ARTIFICIALE, NEUROSCIENZE E PRIVACY

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ABSTRACT

The paper examines the pre-implementation phase, essential for the development of the research denominated "The use of Chat-bot (AI) for the implementation of inclusive didactics in secondary schools", helping to identify scientific studies useful for the theoretical framework (Rega, Di Fuccio, Inderst & Limone, 2024) and to define needs, requirements and restrictions in order to justify the structure chosen for the design, the UDL (Universal Design for Learning) (CAST, 2011, 2024).

Il contributo esamina la fase di pre-implementazione, fondamentale per lo sviluppo della ricerca dal titolo "L'uso della Chat-bot (IA) per l'implementazione della didattica inclusiva nella scuola secondaria di secondo grado", contribuendo a identificare gli studi scientifici utili per il quadro teorico (Rega, Di Fuccio, Inderst & Limone, 2024) e per definire esigenze, necessità e vincoli al fine di giustificare la struttura-quadro scelta per la progettazione, l'UDL (Universal Design for Learning) (CAST, 2011,2024).

KEYWORDS

Personalization, chat-bot (AI), inclusion, teaching-learning process, design
Personalizzazione, chat- bot (IA), inclusione, processo di insegnamento- apprendimento, progettazione

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Introduction

Institutions, that promote formal education (schools and universities), are aware that their tasks include implementing more inclusive processes by facilitating the exercise of the right of all citizens to train, learn and grow, both as a human and professionally, throughout their lives (CAST, 2024; Circolare Ministeriale del 17 maggio 2018, n.1143; Unesco, 2016; Mingardo, 2021; Zambianchi & Ferrarese, 2021).

These institutions, on the one hand, are unable to fully address this challenge linked to the complexity, which is characterized by the predominant use, in all sectors, of the most varied technologies. Among them one of the most powerful is the Artificial Intelligence (AI) which arouses wonder for its applications and great concern for the risks to which it exposes students, young people and adults, linked to personal safety, violation of privacy and civil rights, bringing into question its ethical use (Comandé, 2019; Petrassi, 2024). On the other hand, they, increasingly, highlight the need to interpret technological change, to reshape knowledge on the acquisition of skills and competent attitudes that can allow individuals to become agentive to face composite and changeable realities giving them a body of knowledge capable of forming an open individual, ready for dialogue, able to accept change, the pluralism of perspectives and contribute to active citizenship (Boffo et al., 2022; Consiglio dell'Unione Europea, 2018; Marcone, 2018; UniMi, 2025).

Especially after the Pandemic, we realized that we cannot ignore the valid help of technology in didactics, contemplated not as electronic learning but through the integrated and systematic use in educational and training programs and aimed at promoting active learning processes capable of amplifying communication, knowledge sharing and cooperation, inclusion (Di Blas et al., 2021; Parlamento Europeo, 2023; Piceci & Barbieri, 2022; Terrenghi & Garavaglia, 2024).

With respect to the outlined context, the interest of researchers in the pedagogy and didactics is duplicated: 1) to participate in the promotion of a correct digital education like the ability to approach the new technological tools in a positive and safe way in particular those related to the Artificial Intelligence; 2) to characterize them as tools for didactics in relation to the teaching-learning process so that it is inclusive, allowing students to acquire knowledge, skills and competent attitudes (Piceci et al., 2021).

1. Analysis of the pre-implementation phase of the research: the study

1.1 Methods and materials

The investigation that the researcher carries out in this sense is successful if it is designed according to the state of the art in which it is inserted, on the problem that one wants to address, and the expected change.

To this end, the study of the pre-implementation phase or context analysis is presented, at the basis of the research design (Table 1) denominate ″The use of

February/March Pre-implementation (context analysis): construction of organizational, cultural, technical and didactic conditions	April/May (First half) Implementation: experimental teaching work; monitoring.	Second half of May/June Post-implementation: questionnaire administration data collection	July/August Post-implementation: data analysis	September/ October Post-implementation: data analysis and dissemination

Table 1: Phases of research design

Chatbot (AI) for the implementation of the inclusive didactics in secondary schools″, which contributed to identifying in the theoretical framework the scientific studies useful for determining the needs in terms of requirements, restrictions and necessities the research itself. Examining and evaluating each of these aspects allowed us to answer the guiding question for the context analysis: Is there a framework or design structure to support didactic activities that take advantage of AI (Chatbots) to enhance inclusive teaching and learning processes, while taking into account privacy regulations and data protection requirements?" The context analysis study examined the following theoretical perspectives:

1) conceptualization of inclusion;

2) national, international and University regulations on privacy and management of research data;

3) constructivist and post-constructivist studies that concern the neuroscience vision on the importance of the teaching-learning process shared between teachers and students and supported by the Community of Practice;

4) research related to AI and the use of Chat bot as a teaching tool for generative knowledge.

This has contributed to identifying scientific studies (pre-implementation) (Rega, Di Fuccio, Inderst & Limone, 2024) in order to justify the framework structure chosen for the design, the UDL (Universal Design for learning) (CAST, 2011,2024).

1.2 The concept of inclusion

The first action of the study regarded the meaning of inclusion with the aim of not referring to the categorization of SEN (Special Educational Needs) students, an acronym that gather together those who manifest Special Educational Needs for various reasons (physical, biological, physiological, psychological, social) (Circolare Ministeriale del 6 marzo 2013, n. 8, prot. 561; Nota ministeriale 3 aprile 2019, n. 562) which presupposes difficulties and disadvantages with respect to the performance required for learning in formal training. Despite the prospect of inclusive education, diversity among individuals fosters stigmatization, encouraging the exclusion of many from the education system and training, and from access to essential services to meet personal and professional needs (Arconzo & Bissaro, 2024). The vision of inclusive education is deeper and involves the development of strategies that respond in appropriate times to people's differences.

Institutions of formal education, although in the documents they show interest in this perspective with the adoption of the Functioning Profile, in an ICF perspective which orients towards "global care of the person" (Fedeli & Munaro, 2022, p. 23), they struggle to transfer theoretical principles into practice. In relation to it, some studies highlight the problems encountered in its practical use during the planning of didactic and educational activities due to critical issues linked to the following aspects: the language is not very accessible to all professionals involved in the planning; difficulty to understand the family's point of view; difficulty to understand the concepts that identify physical, relational, mental barriers and facilitators; little proactive vision towards the personal and professional future of the person (Sannipoli, 2020).

Research about the Disability Studies discusses the concept of disability by questioning it and asking what it consists of (D'Alessio, 2018). At the same time, Critical Disability Studies provide us with a complex panorama of its meaning, presenting facets that investigate disability from different points of view such as: form of oppression and categorization; form of stigmatization compared to the norm; vision of independent life in reference to the rights of the UN Convention

(2009); continuum along which the human being moves between disability and non-disability that could affect all individuals (Medeghini, 2015). With respect to these possibilities, we should not imagine students inserted into more or less exclusive categories but assume that each one has educational and didactic needs to which teachers and trainers must listen.

The reasoning is valid for researchers when designing their studies which analyze formal training contexts. Inclusion must be justified through the possession of competent attitudes that allow individuals to become experts in using the essential services for independent living (Marchisio & Curto, 2022), including: education, work, access to medical care, the possibility of being able to request a place to live, and being able to defend oneself legally.

From this perspective, it is necessary for education and training professionals to implement interventions aimed at integrating the dimensions of teaching and learning (De Anna & Covelli, 2021). Concretely, this means paying attention to educational-training practices that must be designed based on the needs of individuals. Despite the complexity of the overview, the main focus is on the sustainability of a design that improves the teaching-learning process, including inclusive learning and didactic approaches that enable transformative value in the learning of all students (Tino, 2024).

1.3 Privacy as a protection for inclusion

The concept of inclusion has placed the protection of privacy of participants at the top. Management of this aspect was essential for the approval of the research protocol «we were not supposed to refer to the person's gender or the disadvantaged condition».

This was possible with the assistance of the Office of Research Ethics and Support to the Ethics Committee of the University of Milan, which has the task of expressing opinions on projects and promoting the development of ethical awareness by referring to national, community and international legal discipline (Regolamento Comitato Etico, UniMi, 2022; Regolamento del Parlamento Europeo e del Consiglio, 14 maggio 2024; Regolamento (UE) 2018/1725). For this reason, they demanded the respect of privacy regarding different phases: administration of the questionnaires, collection and analysis of the data, providing the ethical-legal opinion on the proposal and experimental protocol submitted to their examination. Focusing on these aspects has allowed us approval of the research by the Ethics Committee and to think more critically about Digital Literacy, represented by the

ability of individuals to use new technologies, to actively participate in an increasingly digitalized society and to also use information as training topics to share with students and teachers interested in experimentation (Comandè, 2019).

Knowing the documents of the Agency for Digital Italy (AGID) has further promoted reflection on digital literacy through reading the European digital skills framework DigComp 2.2 (Vuorikari et al., 2022) which aims to improve citizens' digital skills in their free time, at school and at work. The document defines the minimum skills, divided into levels of mastery and according to the expected learning outcomes. Each level represents a stage built on the basis of cognitive difficulties, complexity and autonomy in carrying out activities by the subjects involved through five areas of expertise:

1. Information and data literacy
2. Communication and collaboration
3. Digital content creation
4. Safety
5. Problem solving

Of great interest for the pre-implementation was the area of competence n. 4 concerning the safety to be taken into account for the design work regarding the protection of the devices to be used, of personal data and privacy that has been critically addressed, leaving the path to conscious management by all participants open (Bruni, 2023; Floridi, 2022; Rivoltella et al., 2023).

1.4 Neuroscience, Active Learning, Learning and Practice Communities

The need to reflect on the inclusive teaching-learning process as a requirement for research has directed the study along two lines: constructivist and post-constructivist.

As regards the theoretical framework relating to Constructivism, the principles that regulate the construction of knowledge as an active conceptualisation of the learner who builds his own representations thanks to interactions with the context in which he operates and which plays a decisive role within the learning process have been explored (Brown & Campione, 1994; Calvani & Rotta, 1999; Fabbri, 2007; Fedeli, Grion & Frison, 2016; Kolb, 1984; Vygotski, 1931/2014).

The second, examining the relationship between thought and perception of reality (Rossi, 2013), critically reflects on the centrality of educational-formative practices for the understanding of teaching-learning processes, calling into question the neurosciences that have a holistic view of knowledge.

They confirm the centrality of mental processes of relationship and integration as key dimensions necessary to achieve development and learning (Damiani, Santaniello & Gomez Paloma, 2015; Della Sala 2016) supporting the concept of embodiment which describes the idea of knowledge as an embodied action due to the dyad of the mind and body (Peluso Cassese, 2017; Varela et al., 1991) without neglecting the emotional aspect on which the behavioural response and the possibility of learning in a more or less effective way depends. Trainees also learn from experience; in fact, the brain acquires concepts, notions and relationships much faster if it is pushed to put them into practice, if it experiences them first-hand also through physical and emotional involvement because they facilitate attention and memory (Maggi, 2020). Perception represents a type of action that requires practical knowledge (Zambianchi and Scarpa, 2020) we therefore understand that cognition arises from the dynamic collaboration between the subject who carries out the actions and the environment and this happens through the individual's ability to interact with the context through relational processes that, referred to the learning context, translate into relational bonds with peers and teachers (Gomez Paloma et al., 2015).

By analyzing learning in a social key, attention shifts towards the processes of participation and interaction that feed and sustain the learning context; this means that: knowledge is relational, meaning it is negotiated, learning is subjectively significant and is situated in social practices: learning is not an activity separate from practice (Novak, 2001).

This approach is based on two fundamental concepts: the Community of Practice (CDP) and Legitimate and Peripheral Participation. The Community of Practice is a network of relationships between people, activities and surrounding reality in continuous communication and encounters with other communities. The skills that go around within it are shared by the participants and become the heritage of each (Wenger et al., 2007). Knowledge is transmitted within and between communities, creating bonds.

Socializing peripheral actors means accepting the learning dynamics so that it creates legitimate, competent co-participation even if marginal to the current practices. The term peripheral denotes the existence of a path that new members of the organization are required to follow in order to be recognized as full

participants in the community. Legitimacy consists in the degree of acceptance of novices within the CDP and, once again, the social and not exclusively cognitive nature of the process under examination is underlined. Through the acceptance and involvement of new members, the community reproduces itself.

A reflective structuring takes place through which students and teachers co-construct the learning context, allowing it to change with transformative value and managing to co-configure *«shared inquiry structures over time to channel their individual and collaborative efforts for ever deepening inquiry. As a core assumption, reflective structuration engages students in duplicate- cycle construction: together with the teacher, students build not only content knowledge but also the social contexts and structures in which they work, leading to emergent changes of shared structures that allow their inquiry and collaboration to deepen, expand, and transform over time*» (Tao & Zhang, 2021, p. 406).

Therefore, educational activities that integrate the cognitive, meta-cognitive, relational-emotional and psychomotor aspects are essential for the student, encouraging active learning through methodologies, methods and didactic tools that involve students in the learning process. In this regard, there are many pedagogical processes that exploit the advantages of this approach through methods that stimulate critical thinking skills and, above all, the creativity of students (Bracci & Romano, 2018; EUA, 2019; Fedeli; 2019).

1.5 Chat -bot AI (Artificial Intelligence) as a generative knowledge and active didactic tool

Human creativity, which is expressed in the construction of cultural products: science and technology, art and literature, philosophy and politics, finds its roots in the natural biological incompleteness of man. We can say that in the relationship with reality, man elaborates signs or forms of expression to which he attributes certain meanings and which he uses to define, conceptualize and solve problems, developing competent skills and attitudes (Caprin & Zudini, 2015; Vygotskij, 1934-2019). Human beings contribute to the construction of the reality in which they are immersed through activities that modify it and end up modifying their very nature (Gola, 2020). Engestron (1999) emphasizes the importance of activity intermediaries represented by artefacts of various forms that mediate the relationships between the subject and the environment but also between the subject and himself, in order to construct the environment for action but also for thought (Magakian, 2011).

Artefacts are not objects given in nature but, “artfully made” and as such they reflect and at the same time model the psychic processes of those who constructed them. They represent the “externalized” form of mental processes. In fact, the manifestation of mental activity unfolds on two levels: «a) a […] concrete one that concerns artefacts actually used to carry out a certain activity; b) a […] psychological one, internalized, when the mediation action becomes symbolic» (Ligorio & Cacciamani, 2013, p. 230).

Human beings have the possibility to facilitate their own adaptation through the construction of artefacts, as the technology. On the one hand, it is outlined as a product of nature, of the natural functionality of the brain-mind; on the other hand, nature reveals itself to be continuously exposed to it and is overwhelmed in a pervasive way. In this way, they have the possibility to project their action towards the construction of a possible world (Cuomo et al., 2022; Rivoltella et al., 2023).

Starting from these assumptions, we reasoned about the impact of chatbots, an artificial intelligence tool, in training, considering studies that highlight positive and negative aspects. In general, chatbots models are pre-trained on large amounts of text and able to produce responses from the processing of initial training data, exploiting supervised training and peer reinforcement training (Mancini & Sebastiani, 2024). For this reason, they can learn from a variety of linguistic models (relating to grammar, semantics and context) (Petrassi, 2024; Rivoltella et al., 2023).

The approach that enhances personalized learning is interesting because the tool is able to adapt «the contents and teaching methods to individual needs, thus facilitating inclusion processes and allowing us to overcome physical and cognitive barriers that can represent important obstacles to learning» (Orazi & Moriconi, 2024, p.110). There are some critical aspects to reflect on, for example ChatGPT is based only on statistical models learned from data through training. This limits explanations, personalized feedback; information is generated with many inaccuracies or falsehoods; it manages to avoid plagiarism (Tirocchi, 2024). AI to date does not present complete products from a technical point of view, in fact «All of these solutions currently offer little in the way of "off-the-shelf" solutions, or rather, technically finished products, which nevertheless require analysis and verification in order to avoid trivial and important errors in the delivery of courses to students» (Garavaglia, 2023, p. 1).

Value has been attributed to the chatbot (AI), an artefact and didactic mediator in the learning-teaching process, considering it a LET (Learning Enhancer Tools), an educational-formative tool characterized by affordance, an intrinsic property that

invites the trainee to manipulate and personalize learning according to his/her needs (Rega et al., 2024). As an active learning tool it has been appreciated for the practical opportunity to experiment, encouraging students to collaborate through the performance of cooperative tasks for the pursuit of common goals, implementing reflection on what and how they are learning (Introzzi et al., 2024). The chat bot was intended as a source of generative knowledge as a search engine, reading assistant, rewriting assistant and content generator with the intent of making students protagonists and co-constructors in the process of building knowledge and meanings of reality, allowing them to become consciously responsible for their learning, rather than being passive listeners of the content provided by the teacher.

2. Discussion

The studies presented have traced the context of the research specifying the needs in terms of requirements, restrictions and necessities to be considered for the experimentation, allowing to identify the structure-design framework suitable for the implementation of the inclusive teaching-learning process. The choice fell on UDL (Universal Design for learning) (CAST, 2011) because it responds to adaptive characteristics with respect to the variability of students, taking into account that they could have more or less adaptive capacities (requirements of research).

The framework does not consider individuals in a disadvantaged condition but curricula (objectives, methods, materials and evaluation) because they are addressed to the model of the able student represented in the contexts of formal training. It interprets the main difficulties in training expert students in educational-formative contexts characterized by curricula that provide "a single level for everyone" (CAST, 2011, p. 4) and that for this reason create barriers to learning. Supported by neuroscientific research, it allows for flexible design so that all learners with diverse educational and learning needs, which are diversified, can achieve the expected learning outcomes through flexible practices. Inclusion is exercised if the acquisition of knowledge, skills and competent attitudes is permitted, in a vision of independent life (Marchisio & Curto, 2022), to allow individuals-people, according to their needs, to become experts because they know how to interpret tools and resources to support knowledge.

The conceptualization of inclusion from a UDL perspective has given the possibility to overcome the restrictions linked to the insertion and use of data and has provided the opportunity to obtain approval from the heads of the Research Ethics

Office and the Ethics Committee. In fact, the guidelines of the framework structure indicate how to proceed in the design of activities with an inclusive perspective without referring to the BES categorization:

1) favouring more representation tools allowing students who may be more or less able to assimilate information using visual, auditory or other means rather than just written text.

2) allowing different means of action and expression as students may find themselves in the same condition of disability but with different degrees.

3) allowing the use of different means of involvement because motivation to learn varies from person to person based on individual variables related to affectivity, personal interest, previous knowledge, together with other variables presented in these guidelines.

Universal Design for Learning emphasizes that «the purpose of education in the 21st century is not simply mastery of content or the use of new technologies but mastery of the learning process» (CAST, 2011, p. 4). UDL supports the importance of neuroscience studies because « they provide a solid basis for understanding how the brain interacts with effective teaching» (CAST, 2011, p 12); it values the construct of the Zone of Proximal Development (Vygotskij, 1926- 2006), within which the didactic mediator artefacts (schemes, questions, concept maps, forms, laboratory lessons, work groups, chat bots) and the Community of Practice which implement transformative learning by allowing the student to develop the capacity for self-regulation/meta-cognition. This has allowed us to focus attention on the chat-bot, a mediator-artefact for the personalization of curricula for students (necessities of research) (Rega, Di Fuccio, Inderst & Limone, 2024).

UDL allows teachers and students to share the path to knowledge construction, ensuring that objectives, methods, materials and assessments are flexible; its principles and guidelines can be transferred to any training context, valid for all learning experiences and supporting all teaching styles (Basham et al., 2020).

3. Conclusions

The nature of the design is essentially hypothetical because it does not contain absolute and certain predictions, it should not correspond to a series of regulatory indications that don't leave room for flexibility but should be a guide. It is the conception of what one intends to accomplish or be. Planning indicates both the activity of planning and the result of a first phase of the project (conception,

identification of solution hypotheses, hypothetical answers to the difficulties of the guiding idea) (Coggi & Ricchiardi, 2020).

The UDL as a framework-design structure made it possible to realize an idea, solving the problem related to the demand that guided the pre-implementation phase.

Allowing us to orient the actions towards the hypothesis of the desired result (finding the framework-project structure) through the explanation of the feasibility conditions of the research. At first, this required an analysis of the different aspects characterizing the state of the art in the reference sector, at a second stage the analysis of the context and the implications related to the needs of the experimentation (not categorizing the students); to its restrictions (respect for privacy).

This way of proceeding was important for personalising the path and giving it a strong identity as well as overcoming the abstract conditions that would have prevented its realisation.

Author contributions

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