

PERSPECTIVES ON PERSONALIZATION FOR INCLUSION: PROMPT ENGINEERING AND ICF IN THE CASE OF THE ASKLEA CHATBOT

PROSPETTIVE DI PERSONALIZZAZIONE PER L'INCLUSIONE: PROMPT ENGINEERING E ICF NEL CASO DEL CHATBOT ASKLEA



Gianluca Amatori
European University of Rome
gianluca.amatori@unier.it



Emiliano De Mutiis
European University of Rome & Pegaso Telematic University
emiliano.demutiis@unier.it



Paola Pavone Salafia
European University of Rome & University of Macerata
paola.pavonesalafia@unier.it



Double Blind Peer Review

Citazione

Amatori, G., De Mutiis, E., & Pavone Salafia, P. (2024). Perspectives on personalization for inclusion: prompt engineering and icf in the case of the asklea chatbot. *Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva*, 8(2), Edizioni Universitarie Romane.

Doi:

<https://doi.org/10.32043/gsd.v8i2.1139>

Copyright notice:

© 2023 this is an open access, peer-reviewed article published by Open Journal System and distributed under the terms of the Creative Commons Attribution 4.0 International, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

gsdjournal.it

ISSN: 2532-3296

ISBN 978-88-7730-493-3

ABSTRACT

Artificial intelligence (AI) is greatly influencing learning processes and inclusive dynamics. One of the forms that AI takes in the educational field is conversational chatbots, which have not yet been designed for interaction with pupils with disabilities, effectively excluding them from use. As part of the collaboration between IRCIT and the company Talent, specific prompt engineering techniques, based on ICF profiles, become a useful tool to ensure accessible learning for all.

L'intelligenza artificiale (AI) sta influenzando notevolmente sui processi di apprendimento e sulle dinamiche inclusive. Una delle forme che l'AI assume in campo educativo è quella dei chatbot conversazionali, non ancora progettati per l'interazione con alunni con disabilità, escludendoli di fatto dall'utilizzo. Nell'ambito della collaborazione tra l'IRCIT e l'azienda Talent, specifiche tecniche di prompt engineering, basate sui profili ICF, diventano uno strumento utile a garantire un apprendimento accessibile a tutti.

KEYWORDS

Artificial intelligence; chatbots; inclusive education
Intelligenza artificiale; chatbot; didattica inclusiva

Received 30/04/2024

Accepted 15/06/2024

Published 24/06/2024

Introduction

In recent years there has been a proliferation of educational and neuroscientific studies and research aimed at studying the impact of Artificial Intelligence (AI) on learning processes within innovative educational contexts. The international scientific literature from a pedagogical and didactic perspective shows that Artificial Intelligence, applied to education, is an emerging and priority area for promoting inclusive, engaging and effective learning environments; hence the need to identify a perspective for using AI in curricula, training and supporting teachers. As we shall see, among the many functions AI can perform in education is that of providing personalised tutoring through conversational *chatbots*, software that simulates and processes human conversations (written or spoken), enabling users to interact with digital devices as if they were communicating with a real person.

1. Artificial intelligence in education

The promotion of an innovative and inclusive didactic approach, aimed more specifically at the field of AI research and application in educational contexts, is referred to internationally by the acronym AIED (Artificial Intelligence in Education). In the Beijing *Consensus*, one of the most important international documents on AI and education, drawn up in 2019 (with subsequent revisions in 2020 and 2021), the awareness emerges that the use of AI in education can represent a real educational revolution, guaranteeing accessibility and equal opportunities for all. Technologies supporting teaching and learning processes are increasingly widespread and used in schools, and their constant use is affecting educational processes by modifying teaching practices and learning environments. The concept of innovation, in the educational field, is based on a progressive development of a new didactic perspective, in which the centrality of the student and his active participation in the educational process is fundamental; equity and inclusion are recalled as principles to inspire practices (Panciroli, Rivoltella, 2023).

However, giving an unambiguous definition of Artificial Intelligence is not easy: this depends on the fact that it is a rapidly evolving field and a technology that fits into very different solutions. A frame of reference in this respect is that contained in the European Union's Artificial Intelligence Strategy (April 2018), according to which AI refers to those systems that exhibit intelligent behaviour, capable of analysing their environment and performing actions with a certain degree of autonomy, in order to achieve specific goals. AI systems can operate within specific software (voice assistants, image analysis software, voice and facial recognition systems) or be

embedded in hardware devices (advanced robots, autonomous cars, drones or internet applications).

The international scientific literature with a pedagogical and didactic slant shows how AI, applied in education and training, is an emerging and priority area in order to promote flexible, inclusive, personalised, engaging and effective learning environments (Pancioli, Rivoltella, 2023). That is why it is necessary to find spaces to apply AI in curricula, training and to support teachers. *Smart classrooms* are one of the possible educational applications to host it, in order to set up *dual-teacher classroom* experiences in which 'cobots' flank the classroom teacher as 'co-workers', acting as tutors or peer-educators to guarantee active support to the learning process (*Learning with Robots*).

Among the potential and opportunities for development linked to the use of smart classrooms are: the management and return of *training feedback* through content control to support evaluation and self-assessment during the training and learning phase, a problem still present in today's school anchored on a summative assessment and not very sensitive to presenting error as a factor for educational growth; *interactive learning*, i.e. the possibility of obtaining answers and operational indications from the system; and, finally, *adaptive learning*, i.e. the possibility of adapting the content addressed on the basis of the students' level of knowledge, implementing and guaranteeing customised tutoring by means of AI tools that are not substitutive but generative.

The term 'generative' refers to all software that produces content from information, sounds or images, on the basis of *Deep Learning*, i.e. an artificial architecture that simulates the human brain based on a significant data base and substantial computing power and memory capacity: Deep Learning can be defined as 'a field of research that is based on the creation of multi-level learning models, with particular reference to the learning of verbal and visual data that are not provided by humans, but are learned through the use of statistical computing algorithms with the aim of understanding the functioning of the human brain' (Pancioli, Rivoltella, Gabbrielli, Richter, 2020, p. 5).

In the field of Deep Learning, *Intelligent Tutoring Systems* (ITS) are used as revolutionary tools for personalising learning, simulating personalised one-to-one tutoring. Through these Intelligent Tutoring Systems, it is possible to monitor a student's performance, customising teaching actions on the basis of adaptation to the learning style. ITS are based on a domain that describes the knowledge to be

learned and a pedagogical model that guides the student towards learning objectives: thanks to this information, Intelligent Tutoring Systems can:

- customise the learning path: selecting content and activities suitable for each student;
- offering cognitive support: providing explanations, suggestions and feedback in real time;
- encourage dialogue: stimulating interaction and active learning;
- promoting collaborative learning.

By means of generative AI processes, including those aimed at Text Generation, conversational chatbots represent a new educational challenge, capable of guiding the learner through his or her learning experience: within a *learning-by-teaching* configuration, intelligent tutoring systems keep track of the learner's knowledge, fostering learning progress.

Interesting in this regard is the relationship between 'learning for a human' and 'learning for an AI'; as Di Tore (2023) writes in his article on 'Artificial Intelligence and educational processes', learning in living beings can be classified into different types, such as learning by association, by imitation and by trial and error; when referring to learning for an Artificial Intelligence system, it refers to 'the process of an AI system acquiring new knowledge and capabilities through the analysis of data and the adaptation of its models and algorithms' (Ibid., p. 474). Within AI systems, *Artificial Neural Networks* (ANNs) simulate the biological actions of interconnected brain neural networks, such as those related to learning and the development of associative processes for solving complex problems. This is possible through the replication of hundreds of thousands of simulated neurons enabling the exchange of information. However, unlike the neural networks of living beings, which are able to adapt and modify their behaviour according to different situations and changes, Artificial Intelligence systems must be guided and programmed, and for this reason, as we shall see in the following paragraphs, the correct structuring of the engineering prompts is crucial.

2. AskLea: the generative AI chatbot

The International Research Centre for Inclusion and Teacher Training (IRCIT), set up in agreement between the European University of Rome (Italy) and the Instituto Politecnico de Castelo Branco (Portugal), through a collaboration with the Italian company Talent (a training organisation accredited by the MIUR that has been

active in the field of technological research for many years), is launching a research project based on the principles of generative Artificial Intelligence through a particular chatbot called AskLea; a conversational software designed for study support, aimed at primary, secondary and university students. Unlike other conversational chatbots, AskLea is based on precise educational and pedagogical principles: through the deployment of personalised tutoring - of the kind mentioned above - it does not solve exercises or generate solutions in the student's place, but stimulates him in the development of his own thinking, proposing questions and providing support within his learning process.

Generative AI technology makes it possible to provide each user with a highly flexible learning experience in relation to the characteristics and needs of the student. In this sense, AskLea represents a valuable tool that integrates teaching strategies and learning modes in order to reproduce personalised tutoring at high levels of sustainability and accessibility. Thanks to the potential of AI-based conversational systems, the potential of tutoring is enriched by several features, including:

- the high level of personalisation of the learning experience, centred on the individual learner
- the high frequency of feedback *from* and *to* the learner, enabling the latter to have an active and conscious confrontation on his or her knowledge, identifying learning progress, errors to be corrected or elements on which to focus attention, and recognising the next steps to be taken to reach the learning objective
- the possibility of creating learning experiences in a motivating, stimulating and empathic dimension, outside a logic of judgement. We speak of an emotional motivational experience, in which the AI tutor can be programmed to make the dialogue with the student informal and enjoyable. As a result, the learning experience can be long-lasting and activate deeper learning processes than more typically passive moments for the student such as watching videos, listening to expository phases or reading texts.

This not only allows new content to be acquired, but also enables the student to actively rework it, deepening their understanding.

The experimentation of AskLea has already been launched, in secondary schools and universities. It is an ongoing experiment that has not yet been completed, the analysis of the results of which will make it possible both to validate the behaviour

of Artificial Intelligence systems in didactic and pedagogical terms, and to design new functions to implement the platform with a view to improvement.

3. Personalisation of prompts from an ICF perspective

By Assistive Technologies (AT) we mean all those applications created ad hoc to make hardware or software products accessible and usable to people not only with disabilities, but also to all those with temporary impediments or those who feel more advantaged by the use of these technologies (Panciroli, Rivoltella, 2023); and it is precisely in this developing field that AT based on Artificial Intelligence is placed, with the aim of being facilitators within a pedagogical approach and an inclusive educational environment. Today, it is becoming more and more important and necessary to understand how to develop tools and applications with AI available to people with disabilities, perhaps designed to function just like people with disabilities by trying to overcome the limitation of an interaction mediated entirely by verbal language, so that hidden, non-verbal signals can also be interpreted to understand their needs in advance.

According to the *Universal Design For Learning* model, an environment enriched with educational proposals and interventions necessary to remove barriers and obstacles for some is at the same time useful for all, through the use of inclusive teaching strategies and technologies activated with a view to valuing differences and the full development of individual potential. As also expressed through the ICF (International Classification of Functioning, Disability and Health) drawn up by the WHO, an individual's condition in terms of functioning is nothing more than the result of the interaction between body structures and the facilitating or hindering function that the physical and relational world can exert on the individual's capacity for action and social participation. Even a simple teaching tool can turn into a barrier to participation and learning if it is not prepared to accommodate students' functional differences.

Based on this assumption, IRCIT has been wondering how to make the AskLea chatbot a truly inclusive teaching tool in order to ensure that all students, including those with Special Educational Needs or disabilities, can use it in a fully accessible way.

To accomplish the above, we started from an analysis in terms of the inclusiveness of conversational chatbots, which have not yet been designed for specific interaction with BES pupils, effectively constituting a barrier

In structuring a conversational chatbot from an inclusive perspective, necessary is an adaptation to the characteristics of different disabilities of physical features, communicated imagery, communicative styles, types of concepts, vocabulary, syntax, and emotional tone to the functioning characteristics of the person using them. The use of such customizations can only be based, necessarily, on accurate and centered descriptions of the actual functional characteristics of that particular student with a disability or other BES; descriptions that must, moreover, be both reliable, that is, from competent individuals, and readily available. Since ICF profiles use a standard, unified language with codes and descriptors centered on detailed elements of functioning, the research center (IRCIT) has identified a potential synergy between the conceptual universe of the ICF and the interactivity of AI-based systems.

By acting on the system engineering prompts, i.e., hidden instructions that are provided to the AI model in a special (system) interface, it is possible to set the mode of interaction between the chatbot and the user. To be effective, the prompt must be targeted and expressed simply and directly in line with the goal, specifying the context without leaving room for random interpretation.

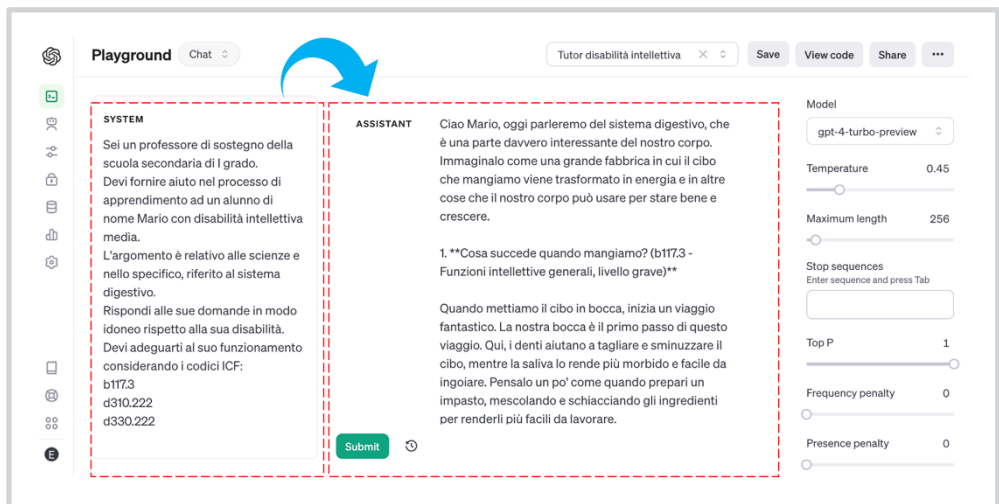


Figure 1 (Example of prompt engineering aimed at custom setting of basic output with reference to ICF codes).

Such system prompts, placed in the “hidden” system message interface, necessarily have a dual nature:

- a fixed and closed part, set a priori and valid for every interaction with students with disabilities or other BES (definition of the role, context, rules of behavior of the model);
- a variable and open part, implemented through input provided by the external user (teacher, parent), aimed at indicating the specific and functional characteristics of that particular student with disabilities or other BES.

Thanks to these open fields of the prompt, it is possible to customize the AI model by the user, through the entry of both general data (name, years, class, discipline, subject) but, more importantly, specific data, thanks precisely to the use of ICF codes. Within the AskLea chatbot, these specific prompts will be implementable by the teacher himself through a rigidly defined and structured graphical interface, where specific student functioning data can be entered with ease. The latter will complement the system prompt, which in turn, will set up the interaction between virtual assistant and student with disabilities in a personalized manner.

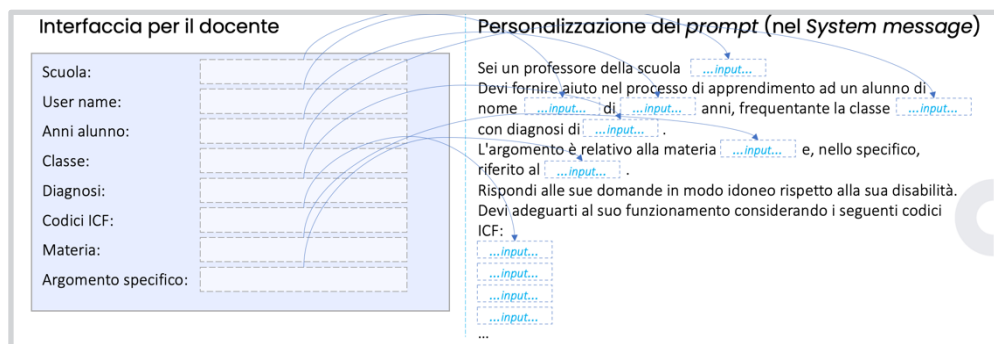


Figure 2 (The personalization of the AI model by the teacher, from an inclusive perspective).

Importantly, a correct and detailed description of functioning through ICF allows for a more appropriate response of the AI model. The chatbot in such a personalized way can be a support for the student with disabilities, in his learning process, to develop knowledge and skills to be poured into group teaching activities with classmates.

But it can also be supportive of the teacher himself, in his teaching actions, not in a substitute function but as - as mentioned at the beginning - “co-workers”:

- in providing materials and cues for teaching interaction, within a communicative triangulation (teacher, student, AI) that allows different modes and directionality;
- in providing modes of interaction suitable for the type of disability, especially in cases where the teacher does not have many skills in this regard.

Conclusions

Artificial Intelligence is increasingly spreading within our society, consequently the world of education is and will be increasingly influenced by this revolution. As Rosemary Luckin of University College of London (2017) writes, there are two main dimensions that need to be explored, regarding AI and education:

1. how can artificial intelligence improve education and help us address some of the big challenges we face?
2. how do we educate people about artificial intelligence so that they can benefit from it?

Paraphrasing his thinking, we can say that AI has the potential to bring about enormous beneficial change in education, but only if we use our human intelligence to design the best solutions to the most pressing educational problems (Luckin, 2017).

In today's society, fostering a culture of AI in order to make individuals proficient in knowing and using its language and logic is crucial; however, technology is not enough: to grasp the educational challenges that AI generates, one must start with a careful analysis and identification of the problems that one wants to address with AI itself..

There are several ways in which an Artificial Intelligence can intervene to support the learning process of human beings; in addition to tutoring through feedback and individualized support to students, adapting the content and pace of learning according to their needs and level of understanding (Di Tore, 2023), there is assessment, a teaching obstacle for many teachers, which thanks to the use of AI can be transformed into a formative, inclusive and explanatory moment of the goals achieved by students, encouraging the development of personalized pathways. On this aspect, AI, in combination with Big Data, represents a valuable support, thanks to the manifold amount of data that emerge from students' use of technological tools (computers, tablets, smartphones, educational robots etc.),

which once collected and organized by the AI tool, can generate information regarding students' cognitive and metacognitive progress, providing invisible, but evidence-based assessment systems.

In order for AI, albeit as a complex challenge, to improve the world of education, it is necessary to train teachers and students in its proper and conscious use through the acquisition of appropriate skills. A real culture on Artificial Intelligence, as a support for human learning and creativity, must, therefore, be created.

The advent of chatbots in educational contexts offers important opportunities in the world of education; despite the high potential of such AI systems, the figure of the teacher must maintain his or her fundamental centrality in teaching-learning processes, both in traditional practice and as a key intermediary in the design of AI systems that are actually useful within the educational sphere. Among the various skills that the teacher must possess, fundamental are the problem solving skills necessary to cope with structural and programming demands with reference to the various activities to be proposed to students.

This paper has highlighted how AI represents the potential to bring change and benefit in educational settings; there is a great deal of new research in this field. However, as we have pointed out, most AI-based systems do not guarantee a high degree of accessibility, since they are not conceived and designed to interact with all different types of human functioning.

In today's educational landscape, inclusion is a central issue, and technology, and more specifically new AI systems, play a key role in making it a reality. The collaboration between the ICRCIT research center and the Talent company opens new frontiers in this area, proposing an innovative approach that gives accessibility and active participation to teaching-learning processes from an inclusive perspective.

These systems, based on detailed descriptive profiles, take advantage of the ICF's conceptual filter and standard, unified language to simulate different types of human functioning, facilitating the structuring of specific, personalized prompts.

The chatbot becomes therefore, a valuable tool for:

- enhance learning: AI systems can tailor the educational path to the specific needs of each student, considering his or her characteristics and learning styles;

- overcome barriers: AI can provide targeted support to students with special educational needs, ensuring equal opportunities for them to learn and participate;
- promoting inclusion: the use of inclusive AI systems fosters the creation of a welcoming school environment that is open to all, where every student feels valued and supported.

This new research perspective introduces new educational opportunities and helps promote inclusion and equity.

References

Anerdi G., Dario P. (2022). *Compagni di viaggio. Robot, androidi e altre intelligenze*. Torino: Codice Edizioni.

Batmaz, Z., Yurekli, A., Bilge, A., Kaleli, C. (2018). A review on deep learning for recommender systems: challenges and remedies. *Artificial Intelligence Review*, 52, 1–37. DOI: <https://doi.org/10.1007/s10462-018-9654-y>

Boden, M. A. (2018). *Artificial intelligence: A very short introduction*. Oxford, UK: Oxford University Press

Castro E., Di Lieto M., Pecini C., Inguaggiato E., Cecchi F., Dario P., Cioni G., Sgandurra, G. (2019). Educational Robotics and empowerment of executive cognitive processes: from typical development to special educational needs. *Form@re*, 19(1), pp. 60-77.

Chi M. T., Siler S. A., Jeong H., Yamauchi T., Hausmann, R. G. (2001). Learning from human tutoring. *Cognitive science*, 25(4), 471-533.

Di Tore P.A. (2023). Artificial Intelligence and educational processes according to Artificial Intelligence. *QTimes*, 15(2), 1. DOI: 10.14668/QTimes_15170

Ferri P. (2013). *La scuola 2.0. Verso una didattica aumentata dalle tecnologie*. Spaggiari Casa Editrice.

Floridi L., Cabitza F. (2021). *L'intelligenza artificiale. L'uso delle nuove macchine*. Milano: Bompiani.

Luckin R., (2017) *Education for a Changing World: the implications of AI for Education* <https://knowledgeillusion.blog/2017/11/08/education-for-a-changing-world-the-implications-of-ai-for-education/>

Panciroli C., Rivoltella P.C. (2022). *Pedagogia algoritmica. Per una riflessione educativa sull'intelligenza artificiale*. Brescia: Morcelliana.

Panciroli C., Rivoltella P.C., Gabbrielli M., Richter O. Z. (2020). Artificial Intelligence and education: new research perspectives. *Form@re*, 20(3), 1-12. <http://dx.doi.org/10.13128/form-10210>

Rivoltella, P. C., Rossi P. G. (2019). *Tecnologie per l'educazione*. Milano: Pearson.

Russel S., Norvig P. (2010). *Artificial intelligence - a modern approach*. Upper Saddle River, NJ: Pearson Education.

VanLehn K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational psychologist*, 46(4), 197-221.

Wang Y., Okamura K. (2020). Automatic generation of e-learning contents based on deep learning and natural language processing techniques. *International 12 Conference on Emerging Internetworking, Data & Web Technologies*, 311–322. Cham, CH: Springer.

Zhang L., Wang S., Liu B. (2018). Deep learning for sentiment analysis: A survey. *WILEs data mining and knowledge discovery*, 8(4). <https://doi.org/10.1002/widm.1253>