Technology with empathy: Using conversational agents in education

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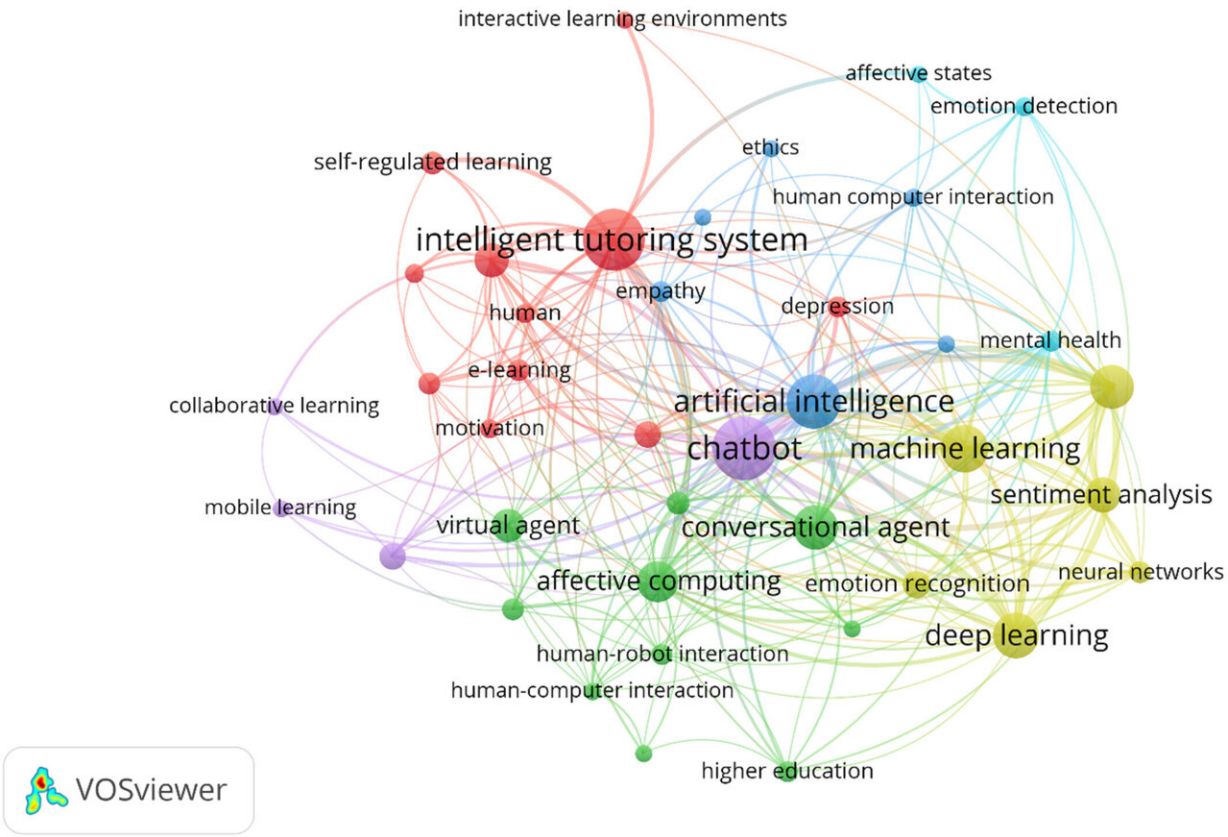

Bibliometric analysis of search results. Credit: *British Journal of Educational Technology* (2023). DOI: 10.1111/bjet.13413

Artificial intelligence and natural language processing technologies are driving the use of pedagogical conversational agents with empathic

capabilities. They are virtual tools (e.g., chatbots) that are able to evoke an empathetic reaction in the student while helping them develop their skills.

As they are always available and increasingly effective in providing support for students and teachers, these technologies are growing rapidly, especially in the areas of improving and personalizing the online learning experience.

However, given their recent inception, there is as yet no broad-based scientific knowledge about the application of these platforms in education, which is why a study by Elvis Ortega-Ochoa, a predoctoral researcher in the SMARTLEARN group at the Universitat Oberta de Catalunya (UOC), focused on the principles that govern these technologies.

A study, published in the *British Journal of Educational Technology*, in which the UOC postdoctoral researcher Marta Arguedas and the member of the UOC's Faculty of Computer Science, Multimedia and Telecommunications, Thanasis Daradoumis also participated, analyzed more than 1,000 studies and articles on the subject in a scientific review of the most important contributions and drew useful conclusions for their development, such as the design principles to be taken into account when beginning the process for creating these agents.

"Conversational agents must have two of the major skills that teachers put into practice in any teaching and learning process: identifying and regulating emotions by various means, and responding to the student's emotional state while progressing in the intellectual construction and development of their skills," explained Ortega-Ochoa, who is producing his doctoral thesis as part of the Doctoral Program in Education and ICT (e-Learning).

The study also provides a comprehensive and state-of-the-art overview of the research designs used in the implementation of these agents. In addition, it examines the factors that influence their effectiveness in education, and also evaluates the types of feedback that improve the impact of empathic agents on learning outcomes.

From chatbots to intelligent tutoring systems

These technological conversational learning tools must enable interaction with the student, either synchronously or asynchronously, and may be integrated into the educational process in various formats and channels: These range from a standalone system, such as a chatbot, to use within an intelligent tutoring system.

"They're currently being used to develop students' soft skills and to provide motivation for students when they're configured with various coaching techniques. At certain points in the teaching process, they can also be useful for introducing new topics or reinforcing content that's already been learned," explained the UOC researcher.

As for their usefulness and students' perceptions, various studies have shown the effectiveness of these conversational tools in improving motivation and learning performance. "We've seen that these benefits are related to the robustness of the interactions with the tool, so the responsibility for success lies with the development techniques used for these services. Virtual agents that frequently use artificial intelligence and empathetic capabilities are less monotonous and interrupt conversations to a lesser extent," added the researchers. The authors also point out that these benefits may be partially subject to the novelty effect inherent in emerging technologies.

Looking toward the future, specialists in the field anticipate that these agents will further refine the pedagogical and empathetic characteristics

presented in the conversations, so that online learning can be more personalized and adapted to students' needs.

"With the rise of artificial intelligence and widely used language models like ChatGPT, educational institutions are more willing to experiment in order to incorporate scientific breakthroughs into the institution's pedagogical model across the board, which means we're likely to have an institutional benchmark in this area in the coming months or within a few years," explained Ortega-Ochoa.

This study makes a significant contribution to providing education and IT professionals with an overview of the latest developments in this field. It lists the design principles to be taken into account when creating these agents, and highlights the transversality of the empathic component in the overall design of the interaction, the promotion of dialogic learning, proficiency in the field of knowledge and personalized feedback according to the student's level. It also shows how the agents were implemented in the learning environments, and provides sufficient factors to take into account when assessing the effectiveness of the design principles.

The study aims to provide a benchmark for educational and technological teams aiming to undertake a project of this type. It also highlights aspects that can be improved, such as the lack of clarity when previous conversations between agents and learners are added to a database in order to determine learning states and personalize responses during the same session.

Finally, the research also discusses ethical considerations related to the use of these agents, and offers some advice for their correct development, such as training the system with unbiased data, ethically managing the information the agent collects, ensuring that its algorithm is inclusive, and preventing it from replicating discriminatory

stereotypes.

The researchers also warn that most studies of earlier projects focused on students' perceptions of the quality, experience and emotional bond generated by the interaction, but few assessed the learning and the level of progress in the development of competencies.

Based on these results, the researchers are now considering the possibility of reviewing the scientific breakthroughs in students' emotion regulation strategies during their interaction with an empathic pedagogical conversational agent, and undertaking an in-depth review of the development techniques of these agents to determine which is the most viable according to the resources of the educational and technological team.

The researchers, along with José Quiroga Pérez and Joan Manuel Marquès Puig, have also published an article in *Internet of Things* that "delves into empathic agents to revolutionize computer competencies acquisition and catalyze motivational, regulatory, and metacognitive dynamics in online higher education."

More information: Elvis Ortega-Ochoa et al, Empathic pedagogical conversational agents: A systematic literature review, *British Journal of Educational Technology* (2023). DOI: 10.1111/bjet.13413

Elvis Ortega-Ochoa et al, The effectiveness of empathic chatbot feedback for developing computer competencies, motivation, self-regulation, and metacognitive reasoning in online higher education, *Internet of Things* (2024). DOI: 10.1016/j.iot.2024.101101

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