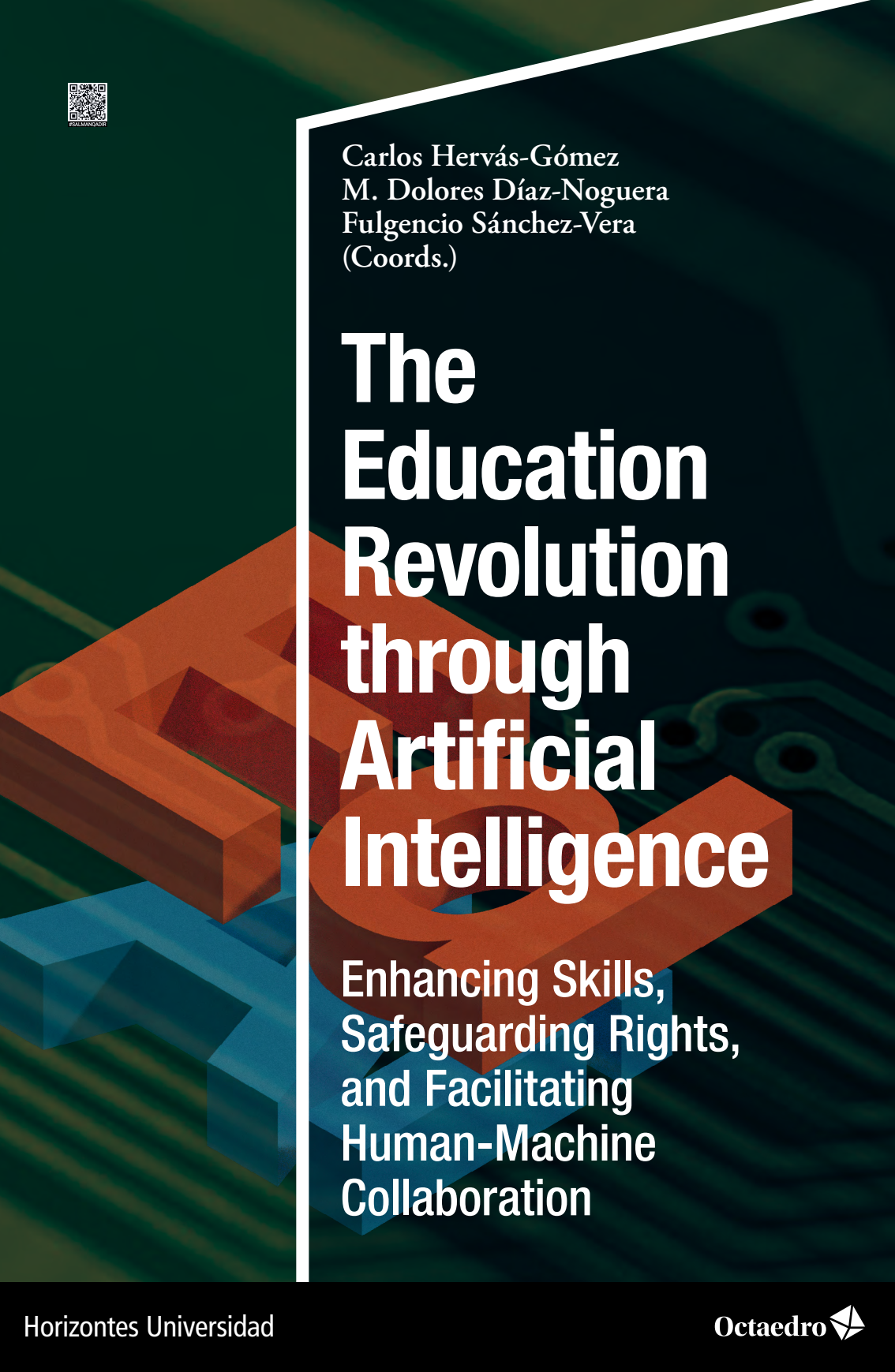


Carlos Hervás-Gómez
M. Dolores Díaz-Noguera
Fulgencio Sánchez-Vera
(Coords.)

The Education Revolution through Artificial Intelligence

Enhancing Skills, Safeguarding Rights, and Facilitating Human-Machine Collaboration

Horizontes Universidad

Octaedro

The Education Revolution through Artificial Intelligence

Enhancing Skills, Safeguarding Rights, and Facilitating Human-Machine Collaboration

Carlos Hervás-Gómez
M. Dolores Díaz-Noguera
Fulgencio Sánchez-Vera
(Coords.)

The Education Revolution through Artificial Intelligence

Enhancing Skills, Safeguarding Rights, and Facilitating Human-Machine Collaboration

Octaedro

Collection Horizontes-Universidad

Title: *The Education Revolution Through Artificial Intelligence: Enhancing Skills, Safeguarding Rights, and Facilitating Human-Machine Collaboration*

First published: november 2024

© From this edition:
Ediciones OCTAEDRO, S.L.
C/ Bailén, 5 – 08010 Barcelona
Tel.: 93 246 40 02
octaedro@octaedro.com
www.octaedro.com

ISBN: 978-84-10282-58-2
DOI: https://doi.org/10.36006/09651-1

Typeset by: Fotocomposición gama, sl
Production: Octaedro Editorial

Open Access

Summary

Prologue

At the threshold of an unprecedented educational revolution, The Education Revolution Through Artificial Intelligence: Enhancing Skills, Safeguarding Rights, and Facilitating Human-Machine Collaboration stands as an essential guide for understanding and navigating the complex landscape of Artificial Intelligence (AI) in education. This meticulously composed book not only addresses the urgency of incorporating AI into educational processes but also delves into the ethical, practical, and philosophical implications of this integration.

From the initial exploration of AI in education, through its necessity and convenience, to its ethical and epistemic impact, each chapter unfolds as a cohesive narrative that illuminates different aspects of AI in the academic realm. We delve into the inclusion of AI in higher education, marking the path towards a digital transformation that promises to redefine what it means to learn and teach in the 21st century.

The book examines how AI is being integrated into academic research and analytical practices, highlighting the technology's potential to enrich qualitative inquiry and knowledge generation. Through an exploration of the challenges, opportunities, and perspectives in redefining linguistic education, to post-pandemic human development in higher education, the authors offer a comprehensive view of the changes that AI is bringing about in the educational landscape.

Chapters dedicated to enhancing learning through the automatic generation of AI-based narratives, students' perception of

AI, and the use of AI tools for creating educational videos illustrate the wide range of practical applications of AI in education. From the use of Dall-E for the self-regulation of learning in elementary school students to the automatic assessment of short answers in health sciences with ChatGPT, the book highlights innovations that are reshaping learning and teaching.

The role of faculty members as ethical mentors in the use of AI in academia, and the experience of project-based learning in higher education, underscore the importance of ethical and practical guidance in adopting these technologies. These themes resonate throughout the book, emphasizing the need for conscious and reflective collaboration between humans and machines.

The Revolution Through Artificial Intelligence is not just a reference work on the integration of AI in education; it is a call to action for educators, students, researchers, and policymakers. It invites all stakeholders to actively participate in shaping an educational future that leverages the potential of AI to enhance skills, safeguard rights, and facilitate effective collaboration between humans and machines. This book marks the beginning of an exciting journey towards an educational revolution driven by Artificial Intelligence, a journey that will transform not only how we teach and learn but also how we think about education in the digital age.

1

Introduction to Artificial Intelligence in Education

PhD Carlos Hervás-Gómez
Universidad de Sevilla, Spain
hervas@us.es
https://orcid.org/0000-0002-0904-9041

PhD M. Dolores Díaz-Noguera
Universidad de Sevilla, Spain
noguera@us.es
https://orcid.org/0000-0002-0624-4079

Eduardo Puraivan
Universidad Viña del Mar, Chile
Universidad de Playa Ancha, Chile
epuraivan@uvm.cl
https://orcid.org/0000-0003-2134-8922

Mg. Macarena Astudillo-Vásquez
Universidad Viña del Mar, Chile
mastudillo@uvm.cl
https://orcid.org/0000-0001-5840-0865

Mg. Connie Cofré-Morales
Universidad Viña del Mar, Chile
connie.cofre@docente.uvm.cl
https://orcid.org/0009-0000-1442-1218

Abstract
Human history is intimately linked to technological progress. From the first tools used in prehistoric times for hunting and subsistence to achievements such as the wheel, the metal industry, the printing press and the steam engine, technology has been a fundamental driver of social development. The educa-

tional sphere is not left out, as Artificial Intelligence (AI) is being firmly incorporated into all sectors, transforming the professional and leisure scopes. The 1956 Dartmouth Summer Research Project is considered to be the origin of AI as a field of study, bringing together leading thinkers to explore new research directions. Today, AI generates advanced digital content, such as generative Artificial Intelligence (GAI), significantly impacting education. For example, online search engines employ AI to provide relevant results from large volumes of user-contributed data. This rapid change in educational practices reflects technology's profound influence on our lives.

Integrating AI in education has brought new possibilities, such as individualizing learning, automating administrative tasks, and creating more interactive and adaptive learning environments. Moreover, AI has proved to be an invaluable tool for enriching the efficiency and effectiveness of educational processes, allowing teachers and students to access personalized educational resources tailored to their specific needs. With the exponential evolution of AI, its impact on education will increase, changing how the world teaches and learns.

Keywords: Artificial Intelligence applied to education, digital transformation, educational innovation, emerging technologies.

1.1. Introduction

Human development depends on the evolution of technology. Thus, in prehistory, we find the first technological advances, where primitive humans began to use tools to hunt and survive (sharp stones, sticks, etc.), which allowed them to obtain food and protect themselves from the dangers of the environment.

As time went by, technological advances followed: the wheel, the metal industry, the printing press and the appearance of the steam engine. These laid the foundations for the Industrial Revolution and ushered in a new era in human history.

Then, the computer revolution, marked by the development of computers in the mid-20th century, allowed people to perform complex calculations faster and more efficiently. In the 1990s, with the emergence of the Internet, the general public could access unlimited information, make purchases, communicate instantaneously, and so on. Another significant milestone in recent decades has been the development of smartphones, which have become an integral part of our daily lives. Today, we are facing another technological breakthrough: the Artificial Intelligence revolution.

Thechnology has consistently and pervasively influenced society throughout the evolution of humankind (Segbenya et al., 2023). It is undeniable that technology has had and continues to have a significant impact on different aspects of our daily lives, transforming how we communicate, how we work, how we learn and how we have fun (Segbenya et al., 2023). It provides us unprecedented opportunities but poses challenges (such as the digital divide and over-dependence on screens) and concerns (privacy, security) or ethical issues like Artificial Intelligence.

Technology insertion into our contemporary society has been pervasive (Hoehe & Thibaut, 2022; Schindler et al., 2017). Undoubtedly, almost every facet of human endeavor has been altered by technology (Haleem et al., 2022). In this sense, as we move towards an increasingly digitized society, it is essential to understand how technology has influenced our human development. According to Cooper (2023), Artificial Intelligence (AI) plays a crucial role in the increasing digitization of society. AI's ability to automate tasks, process vast amounts of data, and provide predictive insights will increasingly revolutionize various aspects of our daily lives (Yang, 2022).

The term 'Artificial Intelligence' is derived from the combination of the words 'artificial' and 'intelligence', i.e., something is said to be artificial if it has been manufactured or fabricated by people rather than naturally occurring. Intelligence can be defined as the ability to acquire and use knowledge and skills (Bolatito, 2024).

1.2. Artificial Intelligence

Today, in the different actions we carry out throughout the day, from how we interact to how we learn, inform ourselves, or make decisions, everything revolves around Artificial Intelligence (European Commission, 2022). It is part of our daily lives (Aoun, 2017). At a general level, and according to the OECD (2019), Artificial Intelligence (AI) is a general-purpose technology that can improve people's comfort, contribute to positive, sustainable global economic activity, increase innovation and productivity, and help respond to global challenges (Bolatito,

2024). For Arslan (2020), Artificial Intelligence is one of the most essential technologies worldwide.

Artificial Intelligence (AI) has become pervasive in everyday life (Adiguzel, Kaya, & Cansu, 2023). A wide range of examples illustrate how AI has penetrated various aspects of human life, such as access to information via the Internet, the consumption of news and entertainment, facial recognition surveillance systems that identify individuals, the performance of financial markets, and the way drivers and pedestrians move around (Williamson & Eynon, 2020). As AI advances, possibilities that were once only speculative may soon become tangible. Recently, a new application called "Sora" has emerged, allowing us to create high-quality videos from text. Therefore, AI can potentially revolutionize different aspects of society, from the business sector to healthcare and education (Alawi, 2023).

According to Solomonoff (2023), the Dartmouth Summer Research Project on Artificial Intelligence, which was held between June 18 and August 17, 1956, is considered the origin of AI as a research discipline. Organized by John McCarthy, Marvin Minsky, Claude Shannon and Nathaniel Rochester, it brought together several dozen leading thinkers in AI, computer science and information theory to explore future lines of research.

However, John McCarthy is considered the inventor of this concept. According to McCarthy, Artificial Intelligence "is the science and engineering of making intelligent computer programs with intelligent machine properties" (Arslan, 2020; Adiguzel, Kaya, & Cansu, 2023).

In this regard, it is worth mentioning that we are increasingly using Artificial Intelligence (AI) systems, sometimes without even realizing it. For example, search engines, intelligent assistants, conversational robots, language translation, navigation applications, online video games and many other applications use Artificial Intelligence in our daily lives (European Commission, 2022).

At the European level, the Artificial Intelligence Act defines it as "software developed using one or more of the following techniques and strategies (machine learning strategies, logic and knowledge-based strategies, statistical strategies, etc...) and that can, for a given set of human-defined objectives, generate output information such as content, predictions, recommendations or

decisions that influence the environments with which it interacts" (European Commission, 2022).

Therefore, we can say that AI is the ability of a machine to manifest human-like capabilities such as reasoning, learning, creating and planning (Arslan, 2020). Therefore, AI is nothing more than using computing machines to think and act humanely and rationally (Allam et al., 2023).

Regona et al. (2022) define AI as "tasks that can be operated automatically by autonomous mechanical and electronic devices using intelligent control". For these authors, there are three conceptualized types of AI: 1) Narrow Artificial Intelligence (N AI), whichis a type of Artificial Intelligence used in language translation and weather forecasting; 2) Artificial General Intelligence (AGI), a type of future AI that will be able to solve complex problems with its thinking and disposition; and 3) Artificial Superintelligence (ASI), which a type of futuristic AI that, if developed, will surpass human capabilities in several areas. As can be seen in Figure 1.1, the principal subfields of AI are (a) machine learning, (b) knowledge-based systems, (c) computer vision, (d) robotics, (e) natural language processing, (f) automated plan-

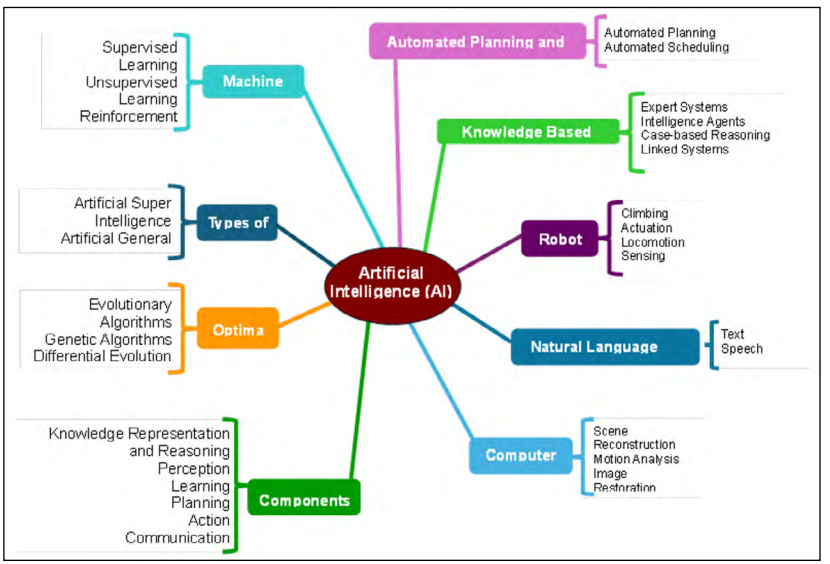


Figure 1.1. According to Regona, Yigitcanlar, Xia, & Li (2022), the components, types and subfields of AI.

ning and scheduling, and (g) optimization (Regona et al., 2022; US Department of Education, 2023

According to the European Parliament (2023), the AI groups are:

- Software: virtual assistants, image analysis software, search engines, voice and face recognition systems
- Embedded Artificial Intelligence: robots, drones, autonomous vehicles, Internet of Things

Figure 1.2 shows some everyday and future uses of Artificial Intelligence according to the European Parliament (2023).

The following are some of the applications of Artificial Intelligence that we use regularly and are not aware of, as reported by the European Parliament (2023):

- Online shopping: AI is used to create personalized recommendations for consumers based on, for example, their previous searches and purchases or other online behavior.

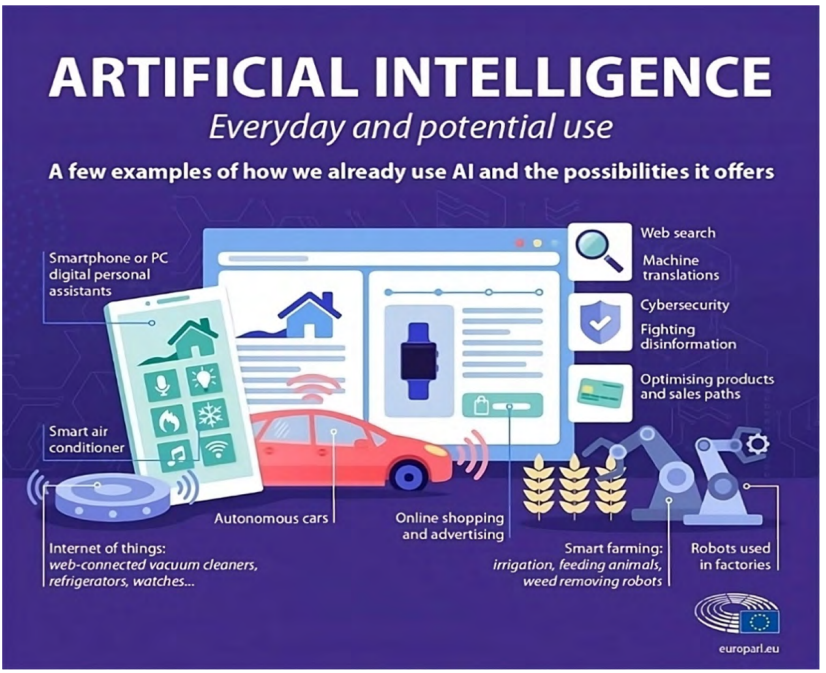


Figure 1.2. Every day and future uses of Artificial Intelligence.

- Internet search: Users provide a lot of data in an Internet search, used by search engines to provide relevant results for users.
- Personal assistants: Smartphones use AI to make the product as relevant and personalized as possible. Virtual assistants answer questions, make recommendations and help organize their owners' routines.
- Machine translations: Artificial Intelligence provides and improves translations or automatic subtitling.
- Smart homes, cities and infrastructure: all the home automation in our homes is learning from our behavior and saving energy; smart villages are aiming to regulate traffic to improve connections and avoid traffic jams.
- Vehicles increasingly use AI-developed safety functions that detect dangerous situations and accidents.
- Cybersecurity: AI helps recognize and fight cyber-attacks and other threats based on the data they receive, recognizing patterns and preventing attacks.
- Disinformation: Some AI applications can detect fake news and disinformation by extracting information from social networks, searching for sensational or alarming words, and identifying authoritative sources.
- Health: AI can analyze large amounts of health data to find patterns that could lead to medical discoveries and other ways to improve individual diagnoses.
- Transport: Artificial Intelligence could improve rail traffic's safety, speed and efficiency by minimizing wheel friction, maximizing speed and enabling autonomous driving.
- Manufacturing: Artificial Intelligence can help companies become more efficient by using robots, optimizing sales routes or with timely predictions of necessary maintenance or breakdowns in 'smart factories'.
- Food and agriculture: AI can be used to build a sustainable food system, ensuring healthier food by minimizing the use of fertilizers, pesticides and the amount of water needed by plants, improving productivity and reducing environmental impact. Many farmers use AI to control their livestock's movement, temperature and feed consumption.
- Public administration and services: By using vast amounts of data and recognizing patterns, AI could foresee natural disas-

ters, enable adequate preparedness and reduce their consequences.

Thus, technologies associated with AI cover a wide range of areas, such as intelligent robotics, natural language processing, language recognition, advanced image recognition, intelligent expert systems, neural networks and machine learning (Adiguzel et al., 2023).

1.3. Artificial Intelligence in Education

Throughout history, technologies using language have been major turning points. These include the invention of writing, which enabled the symbolic treatment of language; the printing press, which facilitated the broader and faster dissemination of knowledge; and the creation of computers capable of processing binary language. All of these milestones led to the age of digital information and technology (Bozkurt, 2023).

Today, a simple academic Google search for the term "Artificial Intelligence in Education (AIED)" yields 4,490,000 results, giving us a glimpse of its enormous scope, with the attention it is receiving evolving at a dizzying pace (Patel & Shahapurkar, 2021; Ilham et al., 2024).

For Grassini (2023), the world has endured a dizzying change in educational practices in the last decade, mainly due to technological advances. Among these technologies, the most influencial has been AI. Recent progress and expansion of machine learning have led to the generation of sophisticated digital content, such as Generative Artificial Intelligence (GAI), capable of aiding education (Bozkurt et al., 2023).

AIED is the practice of using computers and other devices to simulate human perception, decision-making and other processes to accomplish a task. In other words, AI refers to the process by which robots fit complex patterns and learn as they do so (Allam et al., 2023).

According to the European Commission (2022), AI can change the education of students, educational agents, and educational institutions. Nowadays, AI systems help identify specific learning needs, provide students with experiences tailored to

their learning pace, and help schools make effective decisions to use the school's teaching resources efficiently. From this definition, we can identify two types of AI:

- Software: virtual assistants, image analysis software, search engines, and voice and face recognition systems.
- Integrated Artificial Intelligence: robots, drones, autonomous vehicles, Internet of Things.

Today, it is paramount to study how Artificial Intelligence (AI) can improve the teaching-learning process and how AI technology can enable education systems to use modern tools to enhance the equity and quality of education (Allam et al., 2023).

According to Domínguez-González et al. (2023), Artificial Intelligence (AI) is changing the teaching-learning process and reshaping the educational landscape (Naidu & Sevnarayan, 2023; Nipun et al., 2023). For Jamal (2023), "The potential of AI in teacher education is significant, but its application requires careful consideration of ethical, social, technical, and cultural factors. While AI can potentially improve the quality of teacher education, potentiate teacher skills, and facilitate personalized learning, it also raises issues related to data privacy, bias, and cultural acceptability (p.144)". Perhaps the Chat Generative Pre-Trained Transformer (ChatGPT) is the technological development with the greatest impact; it has been trained by deep learning algorithms to generate conversational interactions with user prompts (Fergus et al., 2023). The trained model can answer follow-up questions, admit mistakes, question incorrect premises, and reject inappropriate requests (ChatGPT). As Naudi & Sevnarayan (2023) tell us, "The limitations of ChatGPT are that the quality of the answer provided by ChatGPT (output) will depend on the quality of the question or input. Clear questions and input will generate better responses from ChatGPT" (p.12).

In addition, it has enabled the personalization of learning on a scale that was unimaginable in the past. Thus, it is possible to adapt the content and pace of learning to the individual needs of each student (Istrate, 2019), favoring more effective learning and promoting diversity in the classroom (Biswas et al., 2023). However, the future of AI in education poses significant challenges (Naudi & Sevnarayan, 2023). There is concern that AI

may dehumanize education, reducing teacher roles and human interactions in the learning process. Another challenge is that the implementation of AI in education must be done ethically, avoiding discrimination and ensuring student data privacy (Kerrigan et al., 2022).

The importance of Artificial Intelligence cannot be ignored in this era of innovation and transformation in many fields, including education (Ilham et al., 2024).

1.4. The Possibilities of Artificial Intelligence in Education

According to Karsenti (2019), AI has 26 contributions to education, namely: 1) personalized learning; 2) increased academic success; 3) automatic correction of certain school assignments, thus freeing up time for teachers to work on other tasks, but in this sense the human contribution is still important; 4) continuous assessment of students; 5) teachers can personalize their courses to the limit; 6) intelligent tutoring platforms for distance learning; 7) new ways of interacting with information; 8) educational feedback; 9) personalized learning content; 10) increased opportunities for students to interact; 11) more interaction between students and academic content; 12) better teaching through facilitation rather than content transformation, i.e., as a teacher's assistant; 13) help with homework; 14) more learning, as students are able to interact with their own learning; 15) more learning, as AI can personalize exercises to make learning more meaningful and fun; 16) immersive or virtual environments; 17) dropout prevention; 18) more accessible and engaging distance learning; 19) learner autonomy, a key mission for educators; 20) better classroom management; 21) gamification potential and games contribute to learner engagement; and 22) more efficient administrative processing. In addition, according to Tejawiani, Sucahyo, & Sopian (2023), Maufidhoh & Maghfirah (2023), and Pardamean, Suparyanto, Anugrahana, Anugraheni and Sudigyo (2022), it has been shown that Artificial Intelligence (AI) can increase students' enthusiasm in the teaching-learning process, enhance their creativity and improve their performance.

1.5. Use of Artificial Intelligence

As we use AI, it will be discovered that there are still many problems to overcome in applying it to various processes. In this sense, the most critical question that educational institutions must address is what to teach students in this technology-based society and the many disruptive technologies that will alter how people work. Thus, students must understand that increasingly repetitive and routine work will eventually be mechanized and performed by robots, Artificial Intelligence and automation. However, jobs will always require creativity, intellect and emotional intelligence. Allam et al. (2023) point out that, at present, many institutions do not teach students the skills needed for their future careers. Alam and Hasan (2024) present a list of the current use of Artificial Intelligence in Education:

1. Artificial Intelligence is recently being used to teach knowledge and skills by assessing their skill level and creating guided instruction to make them proficient.
2. Artificial Intelligence is now being used to manage classroom audio-visual devices.
3. AI is now being used to help students learn another language. There are hundreds of languages that work with Artificial Intelligence.
4. AI is very important for preparing lesson plans. Lesson planning communicates to students what they will learn and how they will be assessed.
5. Artificial Intelligence is currently used in chatbots to help students.
6. Artificial Intelligence is currently used to teach students to program.
7. Artificial Intelligence is currently used to facilitate and manage educational games.
8. Artificial Intelligence is currently used to power interactive games that teach children basic needs.

Acknowledgements

This action was financed by the VI Research and Transfer Plan of the University of Seville (VI PPIT-US). It is part of the project entitled Development of Skills in the Production of Educational Videos with Artificial Intelligence for Teaching: An Initiative for Initial Teacher Training (VIDIA-EDU)" within the 4th Teaching Plan of the University of Seville (Spain). Call for Support for Teaching Coordination and Innovation (ref. 221). Call 2023/2024.

References

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionising education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology*, *15*(3), ep429. https://doi.org/10.30935/cedtech/13152

Alam, M., &Hasan, M. (2024). Applications and future prospects of Artificial Intelligence in education. *International Journal of Humanities & Social Science Studies*, *10*(1), 197-206. https://doi.org/10.29032/ijhsss.v10.i1.2024.197-206

Alawi F. (2023). Artificial Intelligence: The future might already be here. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology*, *135*(3), 313-315. https://doi.org/10.1016/j.oooo.2023.01.002

Allam, H., Dempere, J., Akre, V., & Flores, P. (2023). Artificial Intelligence in education (AIED): Implications and challenges. In A. Johnston et al. (Eds.). *Proceedings of the HCT International General Education Conference (HCT-IGEC 2023), Atlantis Highlights in Social Sciences, Education and Humanities, 13, November* (pp. 126-140). https://doi.org/10.2991/978-94-6463-286-6_10

Aoun, J. (2017). *Robot-Proof: Higher Education in the Age of Artificial Intelligence*. The MIT (Massachusetts Institute of Technology).

Arslan, K. (2020). Artificial Intelligence and applications in education. *Western Anatolia Journal of Educational Sciences*, *11*(1), 71-88.

Biswas, P., Sameem, M., & Mallick, L. (2023). Role of Artificial Intelligence in digital transformation of education. *Journal of Data Acquisition and Processing*, *38*(2), 985-989. https://doi.org/10.5281/zenodo.776668

Bolatito, A. S. (2024). The affordances of Artificial Intelligence in education. *Journal of Harbin Engineering University*, *45*(2), 76–85.

Bozkurt, A. (2023). Generative Artificial Intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. *Asian Journal of Distance Education*, *18*(1). Retrieved from https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/718

Bozkurt, A., Xiao, J., Lambert, S., Pazurek, A., Crompton, H., Koseoglu, S., Farrow, R., Bond, M., Nerantzi, C., & Honeychurch, S. (2023). Speculative futures on ChatGPT and generative Artificial Intelligence (AI): A collective reflection from the educational landscape. *Asian Journal of Distance Education*, *18*(1), 53-130. https://doi.org/10.5281/zenodo.7636568

Cooper, G. (2023). Examining science education in ChatGPT: An exploratory study of generative Artificial Intelligence. *Journal of Science Education and Technology*, *2*, 444-452. https://doi.org/10.1007/s10956-023-10039-y

Domínguez-González, M. D. L. Á., Hervás-Gómez, C., Díaz-Noguera, M. D., & Reina-Parrado, M. (2023). Attention to diversity from Artificial Intelligence. *The European Educational Researcher*, *6*(3), 101-115. https://doi.org/10.31757/euer.633

European Commission, Directorate-General for Education, Youth, Sport and Culture, (2022). *Ethical Guidelines on the Use of Artificial Intelligence (AI) and Data in Teaching and Learning for Educators*. Publications Office of the European Union. https://data.europa.eu/doi/10.2766/153756

European Parliament (2023, June 20). *What is Artificial Intelligence, and How Is It Used?* https://www.europarl.europa.eu/topics/en/article/20200827STO85804/what-is-artificial-intelligence-and-how-is-it-used

Fergus, S., Botha, M., & Ostovar, M. (2023). Evaluating academic answers generated using ChatGPT. *Journal of Chemical Education*, *100*(4), 1672-1675. https://doi.org/10.1021/acs.jchemed.3c00087

Grace Solomonoff (May 06, 2023). The Meeting of the Minds That Launched AI IEEE. *Spectrum*. https://spectrum.ieee.org/dartmouth-ai-workshop

Grassini, S. (2023). Shaping the future of education: Exploring the potential and consequences of AI and ChatGPT in educational settings. *Education Sciences*, *13*, 692. https://doi.org/10.3390/educsci13070692

Haleem, A., Javaid, M., Singh, R. P., Suman, R., & Khan, S. (2022). *A Review of Blockchain Technology Applications for Financial Services*. Bench Council Transactions on Benchmarks, Standards and Evaluations, Article 100073. https://doi.org/10.1016/j.tbench.2022.100073

Hoehe, M. R., & Thibaut, F. (2022). Going digital: How technology use may influence human brains and behaviours. *Dialogues in Clinical Neuroscience, 22*(2), 93-07. https://doi.org/10.31887/DCNS.2020.22.2/mhoehe

Ilham, R., Giatman, M., & Maksun, H. (2024). Artificial Intelligence research in education: A bibliometric analysis. *Journal on Education, 6*(2), 13467-13479. https://doi.org/10.31004/joe.v6i2.5199

Istrate, A. M. (2019). The impact of the Virtual Assistant (VA) on language classes. In *The International Scientific Conference eLearning and Software for Education* (pp. 296-301). "Carol I" National Defence University, Bucharest

Jamal, A. (2023). The role of Artificial Intelligence (AI) in teacher education: Opportunities & challenges. *International Journal of Research and Analytical Reviews, 10*(1), 140-146. https://ijrar.org/papers/IJRAR23A2629.pdf

Karsenti, T. (2019). Artificial Intelligence in education: The urgent need to prepare teachers for tomorrow's schools (chronique). *Formation et Profession, 27*(1), 105. https://dx.doi.org/10.18162/fp.2019.a166

Kerrigan, J., Cochran, G., Tabanli, S., Charnley, M., & Mulvey, S. (2022). Post-COVID changes to assessment practices: A case study of undergraduate STEM recitations. *Journal of Educational Technology Systems, 51*(2), 192-201. https://doi.org/10.1177/00472395221118392

Naidu, K., & Sevnarayan, K. (2023). ChatGPT: An ever-increasing encroachment of Artificial Intelligence in online assessment in distance education. *Online Journal of Communication and Media Technologies, 13*(1), e2023xx. https://doi.org/10.30935/ojcmt/13291

Nipun, M. S., Talukder, M. H., Butt, U. J., Sulaiman, R. B. (2023). Influence of Artificial Intelligence in higher education; impact, risk and counter measure. In H. Jahankhani, A. Jamal, G. Brown, E. Sainidis, R. Fong, U. J. Butt (Eds). *AI, Blockchain and Self-Sovereign Identity in Higher Education. Advanced Sciences and Technologies for Security Applications*. Springer. https://doi.org/10.1007/978-3-031-33627-0_7

Organisation for Economic Co-operation and Development (2019). *The Council on Artificial Intelligence Recommendation*. https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449, accessed January 30, 2024.

Patel V. D., & Shahapurkar G. (2021). Artificial Intelligence applications in higher education. *Journal of Advanced Research in Applied Artificial Intelligence and Neural Network, 5*(2), 5-9.

Regona, Yigitcanlar, Xia, & Li (2022). Opportunities and adoption challenges of AI in the construction industry: A PRISMA review. *Journal of Open Innovation Technology Market and Complexity*, *8*(45). https://doi.org/10.3390/joitmc8010045

Schindler, L. A., Burkholder, G. J., Morad, O. A., & Marsh, C. (2017). Computer-based technology and student engagement: A critical review of the literature. *International Journal of Educational Technology in Higher Education*, *14*(25), 1-28. https://doi.org/10.1186/s41239-017-0063-0

Segbenya, M., Bervell, B., Frimpong-Manso, E., Otoo, I. C., Andzie, T. A., & Achina, S. (2023). Artificial Intelligence in higher education: Modelling the antecedents of Artificial Intelligence usage and effects on 21st-century employability skills among postgraduate students in Ghana. *Computers and Education*, *5*, 100188. https://doi.org/10.1016/j.caeai.2023.100188

US Department of Education, Office of Educational Technology (2023). Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations. Washington, DC.

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology*, *45*(3), 223-235. https://doi.org/10.1080/17439884.2020.1798995

Yang, W. (2022). Artificial Intelligence education for young children: Why, what, and how in curriculum design and implementation. *Computers and Education: Artificial Intelligence*, *3*, 100061. https://doi.org/10.1016/j.caeai.2022.100061

2

Artificial Intelligence and Education: Is It Necessary, Is It Convenient?

PhD Enrique Estellés-Arolas
Universidad Católica de Valencia, Spain
enrique.estelles@ucv.es
https://orcid.org/0000-0002-6067-5064

PhD Javier Pérez Bou
Universidad Católica de Valencia, Spain
javier.perez@ucv.es
https://orcid.org/0000-0001-7298-0499

Abstract
Blockchain, cryptocurrencies and metaverse are technologies that have been all the rage in recent years. One might be tempted to add Artificial Intelligence to this group of technologies as just another fad, but unlike these, AI has been able to integrate into many areas of people's lives and find practical use cases. It was already doing so implicitly through virtual assistants (Siri, Alexa, etc.), but now it is doing so openly, with users being aware that they are using AI tools.

What is happening with AI, as has happened with other technologies throughout history, is that its supporters and detractors quickly emerge. And even more so when dealing with a subject as sensitive as education. Some tend to idealize its use, minimizing possible problems or risks, while others tend to fatalize about it and about the havoc it will cause.

Given this situation, it is worthwhile to critically analyze the advantages and disadvantages of AI as an educational tool, always asking the same question: what is in the best interest of the students?

In this book chapter we analyze different use cases and technical reports that will allow us to identify advantages, disadvantages, and good practices.

Keywords: Artificial Intelligence, education, ethics, students, teachers.

2.1. Introduction

Learning from the past

"Books will soon be obsolete in public schools", "[this technology] will make the services of the best teachers available to people" or "children are learning twice as fast as they once did, and retaining what they learn". We might think that these statements were made by technologists, experts in the field of education talking about the use of technologies such as the Internet. The reality is that they were made, in order, by Thomas Edison talking about cinema in 1913, by Benjamin Darrow (founder and principal of a school) talking about the radio in 1932, and by U.S. President Lyndon Johnson talking about the television in 1968 (Cuban, 1986; Wang & Reeves, 2003). All of them were technologies that promised great changes but failed to deliver them.

The past shows us that the history of the use of technologies in education is cyclical and tends to repeat itself. Cuban (1986) identified the structure of this cycle and divided it into 4 phases: euphoria, scientific credibility, disillusionment, and blame. In the first phase, different groups and individuals such as governments, technology companies and the so-called "evangelists" of technology (Reich, 2020), advocate the adoption of technology in the educational environment to change it and improve it in a broad and profound way. In the second phase, numerous studies, often carried out by the very companies that manufacture such technologies (Wang & Reeves, 2003; Desmuget, 2015), are conducted to find credible evidence of the effectiveness of the pedagogical applications of such technologies. The third phase basically consists in the disillusionment and frustration produced by the realization that the technologies introduced in schools do not deliver what was promised at the time. The fourth and last phase is a reaction to the latter, which consists in looking for a culprit. Cuban (1986) mentions the blaming of teachers. Nowadays, digital devices and their ineffectiveness in certain contexts are also pointed out, as in the case of Sweden and the use of computers. In this case, the Minister of Education has paralyzed the digitization plan due to the loss of11 points in the Progress in International Reading Literacy Study 2021 (PIRLS)

report, deciding to limit digital devices and reintroducing textbooks (Crace, 2023).

Interestingly, the sequence identified by Cuban (1986) is similar to that known as the "Gartner Hype Cycle" (Gartner, n.d.), which analyzes the development of fashionable technologies in different fields.

The reasons for failure in the adoption of technologies in education can be multiple and diverse, such as exaggerated expectations that are impossible to meet, lack of understanding of the educational reality or lack of necessary resources. After all, the educational environment is a complex one, where teachers, students, resources, a given socio-cultural context and a series of other elements interact, sometimes in unexpected ways (Reich, 2020). Therefore, interventions that consistently and responsibly analyze the use of technologies in the educational setting, generating evidence to support or discourage it, become necessary (Wang & Reeves, 2003). As Cuban (2018) maintains, "trying to accelerate learning by ramping up technology is like putting rockets on butterfly wings. More force does not lead linearly to more progress."

Facing the present

Currently, the technology that promises to transform education is Artificial Intelligence. It is true that its application in education is not new (Chen, Chen & Lin, 2020; Zhai et al., 2021), but its use has been boosted by recent advances in the field of Generative Artificial Intelligence.

This type of AI makes it possible to generate content (text, images, etc.) in response to a request written in natural language called "prompt". Systems that produce textual content are called LLM (Large Language Models), and GPT (Generative Pre-trained Transformer) is a particular example of these models, which are trained with large amounts of data, allowing them to capture the particularities of language and generate coherent content (Miao & Holmes, 2023).

ChatGPT in particular has substantially changed the educational landscape for two reasons. The first reason is related to the types of tasks it can perform. With a variable level of correctness, ChatGPT and other language models can perform higher-order

cognitive tasks such as elaborating complex texts or summarizing texts, which are tasks that were previously reserved for humans. This has raised legitimate concerns among teachers at all levels: from whether AI will replace them as teachers, to what to do to detect when students use these technologies dishonestly (for carrying out assignments and essays) (OTS, 2023; Miao & Holmes, 2023).

The second reason is its level of popularization. As the first LLM accessible to the general public, it reached the number of 1 million active users in only 5 days and, for example, during the first months of 2023, it had more than 100 million active users (Miao & Holmes, 2023).

Moreover, as is always the case when a technology becomes popular, it is quickly proposed as a teaching tool, thinking that its use will motivate students more in the learning process (Baek, Yung & Kim, 2008). In this sense, numerous researchers have proposed different uses of ChatGPT in education, both for teaching and learning (Ilieva et al., 2023; Kadaruddin, 2023; Lo, 2023; Liu et al., 2024; Newton & Xiromeriti, 2024). One of the most frequently cited examples is the use of ChatGPT as a personal tutor, a type of tutoring with long-established benefits (Juel, 1996). In fact, work on its automation has been underway since the late 1960s, with varying levels of success (Miao et al., 2021; Ilieva et al., 2023). However, it should be noted that there is no universally accepted system for the design, development, and implementation of AI chatbots in educational settings, nor is there robust evidence of their effectiveness (Miao et al., 2021; Miao & Holmes, 2023).

Given the situation described above, in this chapter we will identify and analyze the characteristics of any LLM that must be considered to make a coherent analysis of its use in an educational environment, to attain the maximum benefit.

2.2. Framework of Analysis

To identify and analyze the characteristics mentioned above, it is important to determine the framework of analysis that is going to be used. It is assumed that all technology has a teleological nature, i.e., it is oriented to a specific end or goal (Rescher,

1999). Logically, to achieve this end or goal as efficiently as possible, these technologies are designed in a certain way. However, this does not mean that a technology can only be used for the purpose for which it was designed. That is why it is also said that technology is ambiguous (Ortega y Gasset, 1982) in that it can be used to achieve different ends. This ambiguity, which adds versatility to a technology, implies the possible variation in its efficiency in new uses. The technology will have a maximum degree of efficiency in the task for which it was created (provided it is well designed), but when it is used to achieve other objectives, its level may vary. It will depend on the alignment of the characteristics of the technology and the requirements of the task in question.

For example, video games were designed as a means of entertainment and, although many efforts have been made to use them in education, the result has not been as good as expected or desired (Desmuguet, 2015). On the contrary, the Internet was designed for the exchange of information, not for shopping. However, given its nature and through what Ciborra (2002) called "DIY" processes, today it can be used for many other purposes such as purchasing products or contracting services. In the case of video games, there is no alignment between the technology and the new task to be performed. In the case of the Internet, there is.

In addition, the use of technologies often involves unexpected effects, which are not contemplated in their design, as it is impossible to do so, and this may make their use inadvisable in certain areas. The use of social networks, for example, implies a high degree of disinhibition. This characteristic, which was not contemplated when computer-mediated communication systems were designed, makes their use inadvisable depending on the situation (Shalom et al., 2015).

So how does ChatGPT fit into this objective analysis - ambiguity - unexpected effects scheme?

Characteristics of ChatGPT

a) Objective. The original goal for which ChatGPT was created was to mimic human conversation. Thanks to the use of different AI techniques, ChatGPT is able to produce human-like

text and maintain a conversational style, allowing for more realistic natural and comprehensible dialogues (Tlili et al., 2023). In addition, and to facilitate this goal, other features have been added, such as the so-called "persona pattern", which allows the language model to mimic personalities, characters or emotions during its interactions to facilitate communication (Parra Pennefather, 2023).

b) Ambiguity. Like any technology, ChatGPT has this characteristic. Moreover, being able to simulate a fundamental human skill such as conversation (due the relational nature of the human being), its potential applications are numerous (Kocoń et al., 2023).
c) Unexpected effects. In this aspect, both positive and negative unexpected effects have been found. As positive effects, ChatGPT can perform relatively creative tasks (by composing the knowledge it already has), such as writing poetry or making up stories. It also allows finding alternative solutions (more or less valid) in problem solving (Tlili et al., 2023). Regarding negative unexpected effects, we find several in the literature, although we highlight three for the specific field of education: hallucinations, non-determinism and the existence of biases.

The positive effects extend their versatility even further; however, the negative effects have a very important weight for the case analyzed in the present work. In the following, we will analyze these three negative unexpected effects based on the literature consulted.

2.3. Unexpected effects on language models

Hallucinations

Hallucinations are defined as the production of "content that is nonsensical or untruthful in relation to certain sources" (OpenAI, 2023). This type of erroneous content can be classified in different ways (Van Deemter, 2022; Huang et al., 2023): omissions, wrong and/or invented data, answers that do not relate to the question posed (totally or partially), or logical inconsistencies among others.

This unexpected effect is known by OpenAI, which warns about it on the ChatGPT website and recommends that this technology should be used with special care in contexts where reliability is important. OpenAI (2023) analyzed the expert evaluations of ChatGPT-4 answers in different topics and, although it improved by 19% the correct answers of its previous versions, the correctness evaluation was between 70 and 80%. This problem is also identified in other studies that recommend human intervention for the evaluation of the accuracy and consistency of the answers (Ilieva et al., 2023).

Sometimes, with the aim of minimizing these hallucinations, as well as other problems arising from the use of LLMs such as the generation of inappropriate content, different technics called guardrails have been developed (Tonmoy et al., 2024). However, these guardrails do not work securely either. Liu et al. (2024) indicate that the level of success in using ChatGPT with guardrails in a programming course varied between the different calls, going from 88% success to 39%.

Regarding the area of knowledge, different studies indicate that it does not perform equally well in all areas: ChatGPT excelled in critical and higher order thinking and economics, but its performance was low in law, medical education and mathematics. It also presents problems in identifying sentiment in messages (Kocoń et al., 2023; Lo, 2023; Newton & Xiromeriti, 2024).

Although work is being done and progress is being made on different techniques, apart from guardrails, to mitigate the appearance of these errors (Tonmoy et al., 2024), according to some authors, it is something inherent to the language models themselves and it is difficult for them to disappear (Xu, Jain & Kankanhalli, 2024).

In fact, these hallucinations also occur in EdGPTs, which are models trained on education-specific data (Miao & Holmes, 2023).

Non-determinism

The non-determinism of LLM refers to their inconsistency in their responses given the same prompt, ChatGPT, for example, provides different answers (Tlili et al., 2023). Thus, for the same

question, two learners may randomly receive different, uncomplete or even contradictory information, which goes against fair access to education (Miao & Holmes, 2023).

This non-determinism not only affects the model's responses, but also manifests itself in the blocking or not of certain requests. For example, through the aforementioned guardrails, ChatGPT should not produce inappropriate content. However, the same question at different times may sometimes produce an answer justifying the non-generation of such content, and sometimes the requested content.

Therefore, this non-determinism affects not only the users in terms of the quality of the information they receive, but also the ChatGPT usage rules themselves.

Biases

In this case, the unexpected effect is the biases presented by the models' responses. By design, they tend to amplify the hidden features of their training data, thus reinforcing the positions they represent (Miao et al., 2021). This results in the emergence of political (Fujimoto & Takemoto, 2023), sexual (Miao et al., 2021), racial (Miao & Holmes, 2023), etc. biases. Being data-dependent, removed or fixed biases may re-emerge due to model updates, thus their periodic re-evaluation is inevitable (Fujimoto & Takemoto, 2023).

One way to mitigate these biases would be to use more representative and varied data. However, most of the training data are unknown: OpenAI, for example, partially reported ChatGPT3 data (Brown et al., 2020), but not version 4 data. This is a problem, as it is thus not possible to identify potential problems due to the use of inadequate or biased data sources and implies a significant lack of transparency that affects user confidence (Miao & Holmes, 2023).

Another problem associated with biases is the use that language models make of data from interactions with their users as part of their training (Tlili et al., 2023). This practice raises issues related to data security, but in terms of biases, it again prevents an adequate control.

2.4. Discussion

Language models have a series of unexpected effects that hinder their widespread use in the educational setting. In this sense, it is necessary to differentiate between their use by teachers and by students.

As for students, the key is to find the alignment between the characteristics of the technology and the requirements of the task to be carried out. It is clear, therefore, that if a task requires a language model to provide a 100% valid, reliable, and complete answer in its content, it is not advisable to use it. The same is not true if what matters about the answer is its grammatical structure and not its content, for example. Non-determinism is a problem if a concrete and unique answer is needed (which should also be correct), but it is not a problem if what is sought is the suggestion of topics, ideas, etc., where receiving different answers does not imply a comparative aggravation. A detailed study of what tasks could be carried out based on this technology-task alignment is therefore necessary, always bearing in mind that education is based on and requires truth (Barrio Maestre, 2008).

In addition, it is important to collect evidence of the effects of the use of these models on students to be able to make conscious decisions. For example:

- Its use can make learners lazy and those who are not motivated may use it as a shortcut (Tlili et al., 2023) or fail to adequately review the information provided by the model (Qureshi, 2023).
- Many learners tend to anthropomorphize the model, eventually establishing inadequate trust relationships that break down when hallucinations and inaccuracies are identified (Tlili et al., 2023; Liu et al., 2024).
- Although invited to always have a critical view on ChatGPT and other LLMs' answers (Miao & Holmes, 2023), due to the correct, convincing, and credible expression these models use, students tend to trust without questioning the answers, thereby reducing their critical thinking (OpenAI, 2023; Tlili et al., 2023). For example, 69% of the students who participated in the study of Liu et al. (2024) were very confident or generally

confident in the model's answers, which were valid between 39% and 88% of the time (in different calls).

It is also necessary to train students in the specific use of these models. In this way, problems such as those arising from the use of personal data can be avoided. Some models use interaction data as training data, even though these data are personal. In addition to the problem of a company storing and training an AI system with personal data, it has been shown that it is possible to obtain training data from the model, including such personal data, by means of given prompts (Nasr et al., 2023). These models can be configured not to use such data as training data; however, shouldn't it be configured that way from the start, assuming a data protection approach by design and by default?

Finally, UNESCO (2019) insists that the use of AI technologies in education should be aimed at enhancing human capabilities, not replacing them. On many occasions, what is important is not so much the result to be achieved as the learning involved in the process to be followed. It is therefore important to avoid model dependency, so as not to compromise the development of intellectual skills such as written expression.

As for teachers, AI can enable them to perform their tasks more effectively and efficiently in administrative and teaching tasks (Chen, Chen & Lin, 2020). In their case, the focus is different from that of students, as their job is not to learn content and/or skills, but to transmit them. Even so, teachers should be aware of all the limitations that language models include (biases, hallucinations, non-determinism, etc.), and thereafter use them ethically and professionally. It is important to always review the answers they provide and not to delegate the evaluation to these types of systems by adopting a "human in the loop" approach.

Furthermore, it is important to bear in mind the relevance of the teacher-student relationship. It is fundamental for the well-being of the student, as well as an important factor for ensuring a better academic performance. This relationship is generated based on a complex intersection of beliefs, attitudes, behaviors and interactions between both (Hamre & Pianta, 2006). The tools analyzed in this chapter should not hinder this relationship through, for example, the loss of credibility or trust by working with incorrect or incoherent content generated by the language model.

2.5. Conclusion

Cazzaniga et al. (2024), analyzing the possible effects of generative AI on the labor market, conclude that 60% of jobs in advanced economies are exposed to the effects of the appearance of AI. Of these, one half may benefit from its use, while the other half will be negatively affected. Training in the use of AI is therefore essential, especially at the university level.

On the contrary, the use of AI as a training tool should be taken with caution, analyzing its potential usefulness, and fleeing from the excitement caused by fads that, as seen at the beginning of the chapter, end up entailing frustration for not delivering what others promise for them.

Honest and responsible research is essential in the application of AI to the field of education, analyzing use cases and testing whether improvements in learning occur. As for teachers, they too must (we must) make a responsible and conscious use of AI tools, always prioritizing students' learning.

All those involved must be realistic and aware of the capabilities and limitations of these models, which were designed to replicate human conversation and not to tell the truth, so that then, in the words of the philosopher Emmanuel Mounier, we "do not demand virtues from them that they do not have and do not reproach them for not giving what they do not have to give" (Mounier, 1990).

References

Baek, Y., Jung, J., & Kim, B. (2008). What makes teachers use technology in the classroom? Exploring the factors affecting facilitation of technology with a Korean sample. *Computers & Education*, 50 (1), 224-234. https://doi.org/10.1016/j.compedu.2006.05.002

Barrio Maestre, J. M. (2008). Educación y verdad. *Teoría de la Educación, 20*, 83-102.

Brown, T. B., Mann, B., Ryder, N., Subbiah, M., Kaplan, J., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., Askell, A., Agarwal, S., Herbert-Voss, A., Krueger, G., Henighan, T., Child, R., Ramesh, A., Ziegler, D. M., Wu, J., Winter, C., ... Amodei, D. (2020). Language models are few-shot learners. *Proceedings of the 34th International*

Conference on Neural Information Processing Systems, USA, Article 159, 1877-1901.

Cazzaniga, M., Jaumotte, F., Li, L., Melina, G., Panton, A. J., Pizzinelli, C., Rockall, E., & Mendes Tavares, M. (2024). *Gen-AI: Artificial Intelligence and the Future of Work*. IMF Staff Discussion, note SDN2024/001, International Monetary Fund.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in education: A review. *IEEE Access*, 8, 75264-75278. http://doi.org/10.1109/ACCESS.2020.2988510

Ciborra, C. (2002). *The Labyrinths of Information: Challenging the Wisdom of Systems*. OUP Oxford.

Crace, J. (2023, September 11). Switching off: Sweden says back-to-basics schooling works on paper. *The Guardian*. https://www.theguardian.com/world/2023/sep/11/sweden-says-back-to-basics-schooling-works-on-paper

Cuban, L. (1986). *Teachers and Machines: The Classroom Use of Technology Since 1920*. Teachers College.

Cuban, L. (2018). *The Flight of a Butterfly or the Path of a Bullet? Using technology to transform teaching and learning*. Harvard Education.

Desmuget, M. (2015). *La fábrica de cretinos digitales. Los peligros de las pantallas para nuestros hijos*. Península.

Fujimoto, S., & Takemoto, K. (2023) Revisiting the political biases of ChatGPT. *Frontiers in Artificial Intelligence, 6*. https://doi.org/10.3389/frai.2023.1232003

Gartner (s. f.). *Hype Cycle*. https://www.gartner.es/es/metodologias/hype-cycle

Hamre, B. K., & Pianta, R. C. (2006). Student-teacher relationships. In G. G. Bear, & K. M. Minke (Eds.). *Children's Needs III: Development, Prevention, and Intervention* (pp. 59-71). National Association of School Psychologists.

Huang, L., Yu, W., Ma, W., Zhong, W., Feng, Z., Wang, H., Chen, Q., Peng, W., Feng, X., Qin, B., & Liu, T. (2023). *A Survey on Hallucination in Large Language Models: Principles, Taxonomy, Challenges, and Open Questions*. arXiv. https://doi.org/10.48550/arXiv.2311.05232

Ilieva, G., Yankova, T., Klisarova-Belcheva, S., Dimitrov, A., Bratkov, M., & Angelov, D. (2023). Effects of generative chatbots in higher education. *Information, 14* (9), Article 9. https://doi.org/10.3390/info14090492

Juel, C. (1996). What makes literacy tutoring effective? *Reading Research Quarterly, 31*(3), 268-289.

Kadaruddin, K. (2023). Empowering education through generative AI: Innovative instructional strategies for tomorrow's learners. *International Journal of Business, Law, and Education, 4*(2), 618-625. https://doi.org/10.56442/ijble.v4i2.215

Kocoń, J., Cichecki, I., Kaszyca, O., Kochanek, M., Szydło, D., Baran, J., Bielaniewicz, J., Gruza, M., Janz, A., Kanclerz, K., Kocoń, A., Koptyra, B., Mieleszczenko-Kowszewicz, W., Miłkowski, P., Oleksy, M., Piasecki, M., Radliński, L., Wojtasik, K., Woźniak, S., & Kazienko, P. (2023). ChatGPT: Jack of all trades, master of none. *Information Fusion, 99*, 101861. https://doi.org/10.1016/j.inffus.2023.101861

Liu, R., Zenke, C., Liu, C., Holmes, A., Thornton, P., & Malan, D. J. (2024). Teaching CS50 with AI. *Proceedings of the 55th ACM Technical Symposium on Computer Science Education V. 1 (SIGCSE 2024)*, USA. https://doi.org/10.1145/3626252.3630938

Lo, C. K. (2023). What is the impact of ChatGPT on education? A rapid review of the literature. *Education Sciences, 13*(4), 410. https://doi.org/10.3390/educsci13040410

Miao, F., & Holmes, W. (2023). *Guidance for Generative AI in Education and Research*. UNESCO.

Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). *Inteligencia artificial y educación: guía para las personas a cargo de formular políticas*. UNESCO.

Mounier, E. (1990). *Obras completas* (vol. 3). Sígueme.

Nasr, M., Carlini, N., Hayase, J., Jagielski, M., Cooper, A.F., Ippolito, D., Choquette-Choo, C.A., Wallace, E., Tramèr, F., & Lee, K. (2023). *Scalable Extraction of Training Data from (Production) Language Models*. arXiv. https://doi.org/10.48550/arXiv.2311.17035

Newton, P., & Xiromeriti, M. (2024). ChatGPT performance on multiple choice question examinations in higher education. A pragmatic scoping review. *Assessment & Evaluation in Higher Education*. https://doi.org/10.1080/02602938.2023.2299059

OET, Office of Educational Technology (2023). *Artificial Intelligence and Future of Teaching and Learning: Insights and Recommendations*. U.S. Department of Education.

OpenAI (2023). *Gpt-4 technical report*. arXiv. https://doi.org/10.48550/arXiv.2303.08774

Ortega y Gasset, J. (1982). *Meditación de la técnica y otros ensayos sobre ciencia y filosofía*. Revista Occidente, Alianza.

Parra Pennefather, P. (2023). Generative AI with personalities. In *Creative Prototyping with generative AI* (pp. 65-89). Apress. https://doi.org/10.1007/978-1-4842-9579-3_3

Qureshi, B. (2023). ChatGPT in computer science curriculum assessment: An analysis of its successes and shortcomings. *Proceedings of the 2023 9th International Conference on e-Society, e-Learning and e-Technologies* (pp. 7-13). https://doi.org/10.1145/3613944.3613946

Reich, J. (2020). *Failure to Disrupt: Why Technology Alone Can't Transform Education*. Harvard University.

Rescher, N. (1999). *Razón y valores en la era científico-tecnológica*. Paidós.

Shalom, J. G., Israeli, H., Marko Vitzky, O., LiPsitz, J. D. (2015). Social anxiety and physiological arousal during computer mediated vs. face to face communication. *Computers in Human Behavior*, *44*, 202-208. https://doi.org/10.1016/j.chb.2014.11.056

Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education? *Smart Learning Environments*, *10*(1), 15. https://doi.org/10.1186/s40561-023-00237-x

Tonmoy, S. M. T. I., Zaman, S. M. M., Jain, V., Rani, A., Rawte, V., Chadha, A., & Das, A. (2024). *A Comprehensive Survey of Hallucination Mitigation Techniques in Large Language Models*. arXiv. https://doi.org/10.48550/arXiv.2401.01313

UNESCO (2019). *Beijing Consensus on Artificial Intelligence and Education*. UNESCO Publishing https://unesdoc.unesco.org/ark:/48223/pf0000368303

Van Deemter, K. (2024). The pitfalls of defining hallucination. *Computational Linguistics*, 1-10. https://doi.org/10.1162/coli_a_00509

Wang, F., & Reeves, T. C. (2003). Why do teachers need to use technology in their classrooms? Issues, problems, and solutions. *Computers in the Schools*, *20*(4), 49-65. https://doi.org/10.1300/J025v20n04_05

Xu, Z., Jain, S., & Kankanhalli, M. (2024). *Hallucination is Inevitable: An Innate Limitation of Large Language Models*. arXiv. https://doi.org/10.48550/arXiv.2401.11817

Zhai, X., Chu, X., Chai, C. S., Jong, M. S., Istenič, A., Spector, M., Liu, J., Yuan, J., & Li, Y. (2021) A review of Artificial Intelligence (AI) in education from 2010 to 2020. *Complexity*, *2021*, Article 8812542. https://doi.org/10.1155/2021/8812542

3

The Inclusion of Artificial Intelligence in Higher Education: Moving Towards a digital Educational Transformation

María Jesús Santos Villalba
Universidad de Málaga, Spain
mjvillalba@uma.es
https://orcid.org/0000-0001-6641-0916

José Antonio Martínez Domingo
Universidad de Granada, Spain
josemd@ugr.es
https://orcid.org/0000-0002-4976-7320

Blanca Berral Ortiz
Universidad de Granada, Spain
blancaberral@ugr.es
https://orcid.org/0000-0001-8139-8468

Manuel Enrique Lorenzo Martín
Universidad de Granada, Spain
profesor.manuel.lorenzo@gmail.com
https://orcid.org/0000-0002-1893-216X

Abstract
Artificial Intelligence (AI) is recently emerging in higher education institutions, giving rise to a digital revolution that redefines traditional educational approaches. AI is presented as an innovative technological strategy to improve the efficiency, accessibility and quality of teaching processes. However, teachers today lack specific training that would allow them to explore the various pedagogical opportunities that AI applications can offer to accompany and support students in their educational cycle. The aim of this paper is to analyze the relevance of AI and the teaching role in higher educational contexts.

Teachers should take an active role in the inclusion and supervision of AI applications, making use of their ability to personalize learning and adapt to the individual needs of students. To this end, it is necessary to have acquired digital competencies that allow guiding students in the responsible and critical use of these tools, knowing all of their implications and risks. Collaboration among education professionals will be essential to ensure an effective and ethical implementation of AI in the educational environment.

Keywords: Artificial Intelligence, assessment, learning, teaching.

3.1. Introduction

In recent times, Information and Communication Technologies (ICT) are revolutionizing teaching and learning processes, leading to various advancements across all educational levels. Students are changing the way they learn and access information, while educators are reflecting on their pedagogical practices and introducing new teaching methodologies to adapt to the digital age. The use of technological tools in the educational setting is beneficial for improving the quality of teaching and providing students with greater flexibility and access to knowledge both inside and outside the classroom (Zawacki-Richter et al., 2019).

Higher education institutions are transforming their traditional teaching models to adapt to a society and technology in constant evolution. Therefore, universities must become digitized, provide accessible learning resources and platforms, update academic disciplines, and thus make them more attractive to students (Escotet, 2023).

Among the various technological resources proliferating today, AI has received special attention for its application and impact on educational processes (Aparicio-Gómez, 2023). AI is presented as a technological approach that seeks to develop systems and algorithms capable of performing tasks that, if carried out by humans, would require the use of intelligence.

John McCarthy was the first computer scientist to coin the term "Artificial Intelligence" at the Dartmouth Conference in 1956, based on what was previously known as "computer simulation" (Russell & Norvig, 2010). Since 1956, we have encountered different theoretical interpretations of AI in various fields, such as chemistry, biology, linguistics, and mathematics. From

an educational perspective, AI is understood as a set of computer systems that can perform human processes, such as learning, adapting, synthesizing, and using data for complex processing tasks. Nowadays, advancements in AI are progressing at an ever-increasing pace, impacting the way education is proposed and planned in higher education. In this context, it is also important to note that machine learning is a fundamental area of AI, described as a branch of AI that includes software capable of recognizing patterns, making predictions, and applying them to situations that were not initially predetermined (García-Peña et al., 2020; Hirsch-Kreinsen, 2023).

AI is revolutionizing the way education is delivered and taught, as it allows for personalized teaching approaches and interactive learning experiences. By providing real-time feedback, AI can make interactions between people and computers more personalized and assist in knowledge acquisition (Popenici & Kerr, 2017). AI systems can provide different learning approaches and personalized assessments based on the strengths and weaknesses of students. It also helps identify educational difficulties and provide appropriate responses to each of them. However, Generative AI (GenAI), which can create a variety of data such as images, videos, audio, or text, is revolutionizing the way teaching is taught, planned, and managed in higher education (Dempere et al., 2023).

As we move towards an increasingly digital era, it is necessary to conduct an analysis of the strengths and weaknesses of these technological tools to fully leverage their transformative potential and ensure an equitable educational future. The purpose of this work was to analyze, from an educational perspective, the implications of AI in Higher Education, as well as the teaching role in facing the challenges presented in the teaching-learning processes in the current educational reality.

3.2. Artificial Intelligence in the Current Educational Reality

The educational reality in Spanish classrooms has undergone significant modifications following the approval of the new leg-

islation, Organic Law 3/2020, of December 29, also known as LOMLOE.

Since 1970, there have been six major educational laws that have reformed the Spanish educational system, with perhaps this latest one demanding a profound change from the active body of teaching professionals.

These brand-new changes in methodology and in the evaluation system require teachers to train and familiarize themselves with each of the elements involved in teaching processes. The use of learning situations that focus on active methodologies and student motivation towards greater personalization of learning, the application of Universal Design for Learning (UDL) with its three principles of action (representation, expression, and motivation), and a new exclusively competency-based assessment are the reasons for such a significant change.

The publication of this new legislation and its regional developments coincided temporally with the main changes in the democratization of the use of AI applications, based on the ChatGPT platform from OpenAI, which gave rise to a multitude of new applications that influence the field of education (Goenechea-Permisán & Serván-Melero, 2022; Luckin, 2022).

Why do we link the new legislation to the use of AI in the new reality of classrooms? Because the changes applied to the educational system promote symbiosis between both aspects. Below, we outline what LOMLOE requests from the teaching staff to help us understand it better:

a) Learning based on "situations or experiences" that are linked to the students' close reality.
b) These situations must be relevant and help students achieve the competency profile (specific competencies, key competencies, and exit profile) expected from all students upon completing compulsory schooling.
c) To achieve this competency profile, didactic sequences must be created with the following characteristics: heterogeneity, they should consist of activities, problems, tasks, etc., of different styles that favor the different characteristics of our students; multilevel, they must address the different levels established by Bloom's taxonomy to ensure training and competency improvement, as mandated by the law. This is taken to

the extreme when the purpose of the learning situation is the creation of a product, with "creating" being the pinnacle of Bloom's taxonomy.

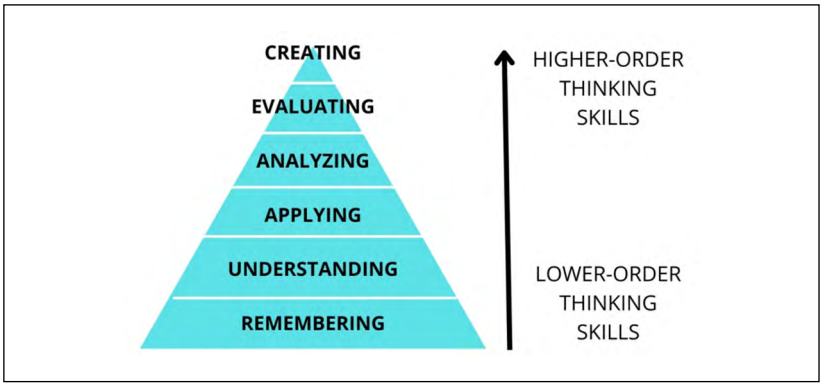


Figure 3.1. Bloom's taxonomy. Source: developed by author.

If we understand the change that implies the entire educational system being dynamized through these premises, we will see that the traditional use of lectures and activities/tasks focused on "remembering" or "understanding," which until recently were predominantly used in Spanish classrooms, fall into the background compared to the need to "multilevel" and "heterogenize" the didactic sequences of our learning situations.

Let us combine this with the emergence of the democratic use of AI models in the daily lives of all of us, including our students. The changes proposed by the new legislation are a great success in addressing this reality prevailing in classrooms today. AI models based on ChatGPT help automate proposals for exercises related to lower-order thinking. That is, proposals such as "summarize the book you have read" are easily achievable through AI applications. However, applying what has been read to the creation of an original product (such as a podcast, a role-playing game, dramatization, or an interactive mind map) requires the application, analysis, evaluation of processes, and creative capacity of the students (Luna-Arcos, 2021; Pueyo & Santisteban, 2023).

Therefore, the new educational reality brought about by the democratization of AI use by the population is indeed compatible with the changes requested by the new legislation. Intensive

teacher training will be necessary in both the good design of learning situations under the "umbrella" of UDL and in the competency-based assessment of students. But once this model can be applied, its synergy with the technological changes brought about by AI in the teaching-learning process will be a great advantage for the entire Spanish educational system.

With the integration of AI into education in Spain, a range of possibilities opens up beyond simple task automation. For example, it can be applied to personalized attention to students' needs and styles. This not only facilitates an individualized approach to the teaching process but also allows teachers to identify and address areas for improvement more efficiently (Mingorance-Estrada et al., 2023).

Additionally, AI can play a fundamental role in evaluating students' progress and skills. Automated assessment systems can provide instant feedback, allowing educators to adjust their teaching strategies in real time and reduce the time invested in such traditionally task-intensive activities (Murgatroyd, 2023). This quick response capability contributes to a continuous feedback cycle that benefits both teachers and students.

However, it is important to address the potential ethical and social challenges that may arise with the widespread incorporation of AI in education. Student data privacy, equity in access to technology, and the need to maintain a balance between technology and human interactions are critical aspects that must be considered in this new educational paradigm.

In conclusion, the relationship between AI and education in Spain promises a significant transformation in the teaching-learning process. While ensuring ethical implementation is necessary, the symbiosis between AI and technological changes can provide a substantial boost to the Spanish education system (supported by the new legislation and the methodological change initiated by it), preparing students for an increasingly digital and complex future.

3.3. Initial Teacher Training and its Implication in the Use of Artificial Intelligence

The growing integration of AI in higher education institutions poses significant challenges and substantial transformations for the teaching staff. As noted by Kuleto et al. (2021), this phenomenon highlights the frequent lack of specific training among professionals, depriving them of the ability to fully explore the pedagogical opportunities offered by AI applications. In this context, attention is focused on initial teacher training, emphasizing its crucial role in the effective integration of AI into Higher Education educational environments.

In the current scenario, initial teacher training is at a critical point that demands adaptation to emerging demands related to educational digitalization and the increasing implementation of AI (Renz & Hilbig, 2020). In response, it is imperative that teacher training programs incorporate meticulously designed specialized modules to provide future educators with the necessary digital competencies (Bonfiel et al., 2020). These competencies not only involve a deep understanding of the theoretical and practical principles of AI but also the ability to apply this knowledge specifically in the field of education.

In this sense, teacher training should focus on familiarizing educators with a variety of AI tools and platforms, providing them with the ability to critically evaluate the effectiveness and applicability of these in the teaching-learning process (Chan, 2023). This formative stage seeks not only to fill a knowledge gap but also to promote a reflective and analytical approach to technology integration.

Beyond the acquisition of technical skills, teacher training in the field of AI should focus on the development of advanced pedagogical skills. This implies training educators to design personalized learning experiences that fully leverage the capabilities of AI (Celik et al., 2022). These experiences should be able to dynamically adapt to the individual needs of students, enhancing the efficiency of the educational process and promoting a more inclusive and student-centered learning environment.

Additionally, the role of teachers in the context of AI cannot be limited solely to technical aspects; it also involves the active

promotion of an ethical approach to technology use (Cope et al., 2020). Teacher training should address crucial issues related to privacy, equity, and transparency in the use of AI. This ensures that educators are fully equipped not only to use these technologies effectively but also to guide students in their responsible and critical use.

In this broader context, initial teacher training is considered to play a fundamental role in preparing educators to address the challenges and capitalize on the opportunities presented by the inclusion of AI in Higher Education (George & Wooden, 2023). Comprehensive and specialized training not only empowers teachers to effectively lead digital educational transformation but also ensures an ethical and effective implementation of AI in educational processes.

To achieve this goal, collaboration among educational institutions, education professionals, and AI experts is considered an essential component. The synergy of these actors allows for the development of innovative educational strategies, addressing ongoing ethical challenges, and continuously adapting teacher training to reflect rapid advances in AI (Zhang & Aslan, 2021).

In conclusion, the integration of AI into Higher Education represents a paradigm shift that requires a proactive response in terms of teacher training. This process must encompass not only the transmission of technical knowledge but also the development of advanced pedagogical skills and solid ethical awareness. Only through comprehensive and collaborative training can we ensure a successful educational transition towards a more advanced and technologically integrated paradigm.

3.4. Conclusions

In contemporary times, there has been an imminent emergence of AI in institutions of higher education, triggering a digital revolution that redefines conventional educational approaches. This radical change responds to the growing need to enhance the efficiency, accessibility, and quality of teaching processes. Despite being presented as an innovative technological strategy with the potential to transform higher education, AI faces significant challenges, one of which is the lack of specific teacher training to

fully explore the various pedagogical opportunities that these applications can offer students in their learning journey.

In this context, the relevance of AI and the role of faculty in higher education contexts were analyzed. The fundamental importance of active faculty participation in the inclusion and supervision of AI applications is recognized, assuming a central role in these processes (Kamalov et al., 2023). The ability to personalize learning and adapt to the individual needs of students becomes an essential element for the success of these initiatives.

One of the crucial challenges highlighted is the lack of specific teacher training in the field of AI, an aspect that requires priority attention. This is because the rapid evolution of technology demands that faculty acquire specific digital competencies to fully leverage the pedagogical opportunities of AI in the classroom (Meylina et al., 2021). Training must go beyond mere technical understanding of AI applications; it is imperative that faculty develop skills to effectively integrate these tools into their pedagogical practices.

This teacher training should encompass understanding the fundamentals of AI, its application in the field of education, and the ability to critically evaluate available tools. This training will not only ensure that educators are aware of the latest technology trends but also enable them to guide students in the responsible and critical use of AI applications (Almusaed et al., 2023).

Faculty members, by assuming an active role in the inclusion and supervision of AI applications, become a catalyst for the success of these technologies in higher education. Furthermore, Kim et al. (2022) pointed out that active faculty presence is essential to ensure that AI is used effectively and ethically, and student-centered. Educators must play a proactive role in selecting AI tools aligned with pedagogical objectives and fostering an inclusive learning environment.

The ability of AI to personalize learning according to the individual needs of each student is one of its most promising aspects. However, to maximize this potential, it is essential that faculty play an active role in configuring and adapting tools to meet the specific needs of their student group. Therefore, effective personalization of learning through AI requires a deep understanding of students' individual characteristics by faculty (Minn, 2022).

Collaboration among education professionals emerges as a crucial element to ensure the effective and ethical implementation of AI in the educational environment. This collaborative approach involves not only sharing knowledge and experiences but also working together to develop digital competencies that enable ethical and responsible guidance of students in using these tools.

Ethics in the implementation of AI in higher education is positioned as a topic of great importance. Faculty must be equipped with knowledge about the ethical and social implications of AI, as well as the ability to guide students in the reflective and critical use of these tools. Thus, ethical training of faculty is essential to ensure that AI is used fairly and equitably, avoiding biases and discrimination (Roche et al., 2023).

Additionally, collaboration among education professionals is presented as a key element for the effective implementation of AI in higher education. The diversity of knowledge and skills within the faculty allows for a holistic approach that encompasses everything, from selecting AI tools to adapting pedagogical methods, with the aim of fully leveraging these technologies.

In conclusion, the integration of AI in higher education is a reality that poses significant challenges and opportunities. The active role of faculty is essential to ensure that AI is used effectively and ethically, and student-centered. Specific training in digital competencies and ethics, collaboration among education professionals, and the ability to personalize learning are key elements to fully leverage the transformative potential of AI in higher education. To address current and future challenges of the implementation of AI in higher education, continuous commitment to faculty training, the development of student-centered AI tools, and the promotion of a culture of collaboration and ethical reflection in educational institutions are necessary. Haga clic aquí para escribir texto.

References

Almusaed, A., Almssad, A., Yitmen, I., & Homod, R. Z. (2023). Enhancing student engagement: Harnessing AIED's power in hybrid education. A review analysis. *Education Sciences*, *13*(7), 632. https://doi.org/10.3390/educsci13070632

Aparicio-Gómez, W. O. (2023). La Inteligencia Artificial y su Incidencia en la educación: transformando el aprendizaje para el siglo XXI. *Revista Internacional de Pedagogía e Innovación Educativa*, *3*(2), 217-229. https://doi.org/10.51660/ripie.v3i2.133

Bonfield, C. A., Salter, M., Longmuir, A., Benson, M., & Adachi, C. (2020). Transformation or evolution? Education 4.0, teaching and learning in the digital age. *Higher Education Pedagogies*, *5*(1), 223-246. https://doi.org/10.1080/23752696.2020.1816847

Celik, I., Dindar, M., Muukkonen, H., & Järvelä, S. (2022). The promises and challenges of Artificial Intelligence for teachers: A systematic review of research. *TechTrends*, *66*(4), 616-630. https://doi.org/10.1007/s11528-022-00715-y

Chan, C. K. Y. (2023). A comprehensive AI policy education framework for university teaching and learning. *International Journal of Educational Technology in Higher Education*, *20(*1), 38. https://doi.org/10.1186/s41239-023-00408-3

Cope, B., Kalantzis, M., & Searsmith, D. (2021). Artificial Intelligence for education: Knowledge and its assessment in AI-enabled learning ecologies. *Educational Philosophy and Theory*, *53*(12), 1229-1245. https://doi.org/10.1080/00131857.2020.1728732

Dempere, J., Modugu, K., Hesham, A., & Ramasamy L. K. (2023). The impact of ChatGPT on higher education. *Frontiers in Education*, *8*, 1-13. https://doi.org/10.3389/feduc.2023.1206936

Escotet, M. Á. (2023). The optimistic future of Artificial Intelligence in higher education. *Prospects*. https://doi.org/10.1007/s11125-023-09642-z

García-Peña, V. R., Mora-Marcillo, A. B., & Ávila-Ramírez, J. A. (2020). La inteligencia artificial en la educación. *Dominio Ciencia*, *6*(3), 648-666. http://doi.org/10.23857/dc.v6i3.1421

George, B., & Wooden, O. (2023). Managing the strategic transformation of higher education through Artificial Intelligence. *Administrative Sciences*, *13*(9), 1-20. https://doi.org/10.3390/admsci13090196

Goenechea-Permisán, C., & Serván-Melero, C. (2022). *Análisis de la reciente actualización del currículum desde la dimensión cívica de la inteligencia artificial y el big data*. Dykinson.

Hirsch-Kreinsen, H. (2023). Artificial Intelligence: A "promising technology". *AI & Society*. https://doi.org/10.1007/s00146-023-01629-w

Kamalov, F., Santandreu-Calonge, D., & Gurrib, I. (2023). New era of Artificial Intelligence in education: Towards a sustainable multifac-

eted revolution. *Sustainability*, *15*(16), 12451. https://doi.org/10.3390/su151612451

Kim, J., Lee, H., & Cho, Y. H. (2022). Learning design to support student-AI collaboration: Perspectives of leading teachers for AI in education. *Education and Information Technologies*, *27*(5), 6069-6104. https://doi.org/10.1007/s10639-021-10831-6

Kuleto, V., Ilić, M., Dumangiu, M., Ranković, M., Martins, O. M., Păun, D., & Mihoreanu, L. (2021). Exploring opportunities and challenges of Artificial Intelligence and machine learning in higher education institutions. *Sustainability*, *13*(18), 10424. https://doi.org/10.3390/su131810424

Luckin, R. (2022). *AI for School Teachers (AI for Everything)*. CRC.

Luna-Arcos, F. (2021). El nuevo currículo a partir de la LOMLOE. *DYLE: Dirección y Liderazgo Educativo*,*10*, 13-15.

Meylina, M., Ardiasih, L. S., & Rahmiaty, R. (2021). Teachers' digital competences: An overview on technological perspectives. *Linguists: Journal of Linguistics and Language Teaching*, *7*(2), 29-43. http://dx.doi.org/10.29300/ling.v7i2.5489

Mingorance-Estrada, A. C., Lorenzo-Martín, M. E., El Homrani, M., & Torres-Martín, C. (2023). *Didáctica, procesos y contextos educativos*. Comares.

Minn, S. (2022). AI-assisted knowledge assessment techniques for adaptive learning environments. *Computers and Education: Artificial Intelligence*, *3*, 100050. https://doi.org/10.1016/j.caeai.2022.100050

Murgatroyd, S. (2023). Rethinking teaching in the age of Artificial Intelligence. *Revista Paraguaya de Educación a Distancia (REPED)*, *4*(2), 4-10. https://doi.org/10.56152/reped2023-vol4num2-art1

Popenici, S. A. D., & Kerr, S. (2017). Exploring the impact of Artificial Intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(22), 1-13. https://doi.org/10.1186/s41039-017-0062-8

Pueyo, N., & Santisteban, A. (2023). Utilizando la inteligencia artificial para crear un proyecto sobre la Antigua Grecia en la ESO. *Aula de Secundaria*, *51*, 37-41.

Renz, A., & Hilbig, R. (2020). Prerequisites for Artificial Intelligence in further education: Identification of drivers, barriers, and business models of educational technology companies. *International Journal of Educational Technology in Higher Education*, *17*(1), 1-21. https://doi.org/10.1186/s41239-020-00193-3

Roche, C., Wall, P. J., & Lewis, D. (2023). Ethics and diversity in Artificial Intelligence policies, strategies and initiatives. *AI and Ethics*, *3*(4), 1095-1115. https://doi.org/10.1007/s43681-022-00218-9

Russel, S., & Norvig, P. (2010). *Artificial Intelligence. A Modern Approach*. Pearson Education.

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on Artificial Intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(39), 1-27. https://doi.org/10.1186/s41239-019-0171-0

Zhang, K., & Aslan, A. B. (2021). AI technologies for education: Recent research & future directions. *Computers and Education: Artificial Intelligence*, *2*, 100025. https://doi.org/10.1016/j.caeai.2021.100025

4

The Ethical and Epistemic Impact of Artificial Intelligence in Education

Inmaculada Perdomo Reyes
Universidad de La Laguna, Spain
mperdomo@ull.edu.es
https://orcid.org/0000-0003-4838-7278

Fulgencio Sánchez-Vera
Universidad de la Laguna, Spain
fsanchev@ull.edu.es
https://orcid.org/0000-0002-0697-9120

Betty Estévez Cedeño
Universidad de la Laguna, Spain
bestevec@ull.edu.es
https://orcid.org/0000-0002-1590-952X

Abstract
This chapter examines the impact of Artificial Intelligence (AI) on education and creative work, highlighting the need for interdisciplinary analysis in the context of the interrelationship between technoscience and society. The ethical challenges of AI, such as algorithmic biases and epistemic injustice, and its influence on educational and decision-making processes are discussed. The text emphasizes the importance of regulation and accountability in the use of AI to preserve democratic values and fundamental rights, while also reflecting on the future of education in the age of AI.

Keywords: Artificial Intelligence, education, society, ethical challenges, epistemic injustice

4.1. Theoretical Approach: Technosciences and Society

In science, as in any other human cultural practice, values and interests are present in different forms and degrees at different stages of the scientific process. Moreover, scientific knowledge is the result of controlled research, thus experimentation and interpretation of data must satisfy the minimum level of empirical adequacy, although these are issues subject to contextual value-based decisions. Therefore, from the formulation of the questions that point out a research problem and the objectives set (cognitive and pragmatic or application), the selection of the most appropriate methodologies to address it, the processes of extraction, selection and interpretation of data, the delineation of hypotheses, the texture of the inferences, the results and even the public communication of the latter imply value-based judgments. The knowledge capitalization era (Echeverría, 2003) requires a more comprehensive interdisciplinary effort that enables the analysis of all the relevant aspects involved, focusing on the inherent and shaping values of technoscientific practice itself.

The term "technoscience", originally proposed by Bruno Latour in 1983, refers to the fusion of science, technology, industry and the military (Echeverría, 2003), as well as the hybridization of this complex and society. These developments are accompanied by radical changes in the ontological premises of the technosciences, as well as in some of their rhetorical and political strategies. From these multifaceted changes come new epistemologies and methodologies that emphasize the constructionist character of categories such as science, technology, and society. Science, Technology and Society (STS) theoretical approaches pay attention to these new challenges from strategies and concepts that capture the reality of this new organization of scientific-technological practice. These are "socio-technical systems, hybrid systems involving individual people, but also corporate actors such as companies and government bodies, as well as more abstract social entities such as institutions, laws and regulations, and other rules" (Franssen and Kroes 2009, p. 223). Proposals such as that of Jasanoff (2004, 2016) invites to modify the ap-

proach to capture the emerging characteristics of such hybridization: the configuration of *socio-technical imaginaries*, linked to the concept of co-production of science, technology and society. Unveiling these socio-technical imaginaries helps to explain why some scientific and social visions tend to gain more support and authority, and why some develop at the expense of others.

The analysis of the impacts of AI systems requires a critical analysis. Here, interdisciplinarity is absolutely necessary: technical and legal, philosophical, political, ethical and educational aspects are intertwined in the social phenomenon of AI. It is a major challenge for which the theoretical approach of STS Studies of co-production or mutual conformation of technoscience-society is proving to be fruitful (Wajcman, 2023). A diversity of actors or social agents transit and interact with the technoscientific system. They exercise their capacity to co-produce (unexpected or unforeseen uses of certain technologies, resignification, transformative symbolic uses, modification of values and behaviors, dissident narratives...) technology and its meanings. In this system, it is necessary to introduce the gender perspective in an intersectional key to address complexity in an effective and fruitful way and to develop research on this continuous dynamic.

4.2. From Expert Systems to Dataism and Epistemic Injustice of AI

AIs with autonomous learning based on neural networks are capable of making correlations and inferences from the millions of data they use (databases, images, results of human interactions with smartphones, etc.), reflecting, as if it were a mirror, the accumulation of human traits and characteristics. The Latin word *datum*, which comes from *dare* (to give), literally means *given*. Knowledge in the information regime strives to achieve total knowledge through algorithmic operation, substituting the narrative for the numerical. Dataism aims to calculate everything that is and will be (Byung-Chul Han, 2022, p. 21).

On the other hand, they also reflect the biases, prejudices and stereotypes that continue to structure our societies. The *algorithmic bias* acquired through data are multiple and varied. These are

related to the very nature of databases that do not actually represent the entire population (Criado, 2019). Generative AIs reify and circulate existing gaps and biases, but they give them a veneer of objectivity and neutrality despite the opacity of most of these processes. They can be true automated mechanisms of reproduction and generation of inequalities and exclusion (Eubanks, 2018). Technologies are both a reflection and a crystallization of social processes. Even so, there are still few studies focused on how power and gender relations end up integrated into technoscience, from the design to the setting of pragmatic goals, but it is widely recognized (Wajcman & Young, 2023) that both the workforce and the dominant cultures in technoscience are clearly representative of the groups of people that make up it, and that women, for example, do not represent more than 17-19% (Young, Wajcman, & Sprejer, 2023). In this way, AI as a disruptive technology represents a biased prolongation of the knowledge production model. Such a situation is of clear algorithmic and epistemic injustice and faces major challenges in education, at work and, especially, in public decision-making processes and in the generation and transfer of knowledge.

Algorithmic injustice is reflected by not considering the epistemic contribution of vulnerable voices or groups, underestimating the importance of contextual categories, both material and immaterial (Abdilla, 2021) and of corporeal entities or agential realism (Barad, 2007) of minorities, which are relegated to the products of the large AI technology industries (Catá, 2023), all of which are examples of the Western capitalist model. Therefore, the production of technoscientific knowledge is subject to algorithmization. In other words, the sociocultural processes, data, and institutions that, in natural language, we may -or may not- recognize as authoritative agencies of knowledge become algorithmic models of the globalized world.

New AI-mediated narratives construct hegemonic algorithmic cultures (Striphas, 2015 cited in Ricaurte, 2022). When the 'XCheck' program created by Facebook and initially designed a mechanism to review in more detail the measures taken against high-profile accounts, it ended up becoming a system that rather exonerated numerous celebrities, politicians or journalists from complying with the rules that are imposed on other users. This shows that, when an algorithmic sociocultural model is pro-

duced, there is a high probability of prolonging or generating a new version of capitalism, colonial and patriarchal (Ricaurte, 2022). Therefore, the role of ethics or the development of responsible AI (Torrones, 2020) becomes a core issue.

The work situation experienced in 2018 by Timnit Gebru and Margaret Mitchell,[1] both pioneering AI ethics researchers and former Google employees, suggests that, in a world imbued with bias, algorithmization enhances existing differences. Thus, an ethic code for the majority of the world (Ricaurte, 2022) in times of AI must be based on the recognition of deliberation as a cornerstone of technoscientific development and as a necessary dose of humanity in the construction of the new technology.

4.3. Generative AIs and Impacts in the World of Creative Works and Education

Nowadays, machines cross (or replace) the immaterial, cognitive and cultural work, the communicative activity of society and the deliberative capacity of citizenship. They learn by themselves, that is, it is no longer necessary to instruct them. They can find rules, correlations between x and y, not even foreseen by humans (which means significant advances in disciplines such as Medicine, when it comes to accurately diagnosing a disease from multiple and varied symptoms). However, machines do not know why this is the case. It is still a profoundly human task to give an account of the why, to clarify the frames of reference, the prior assumptions, the values and the objectives set. Although assisted by AI systems, human beings can increase the accuracy and speed of responses to decision-making but cannot be replaced by machines.

In addition, delegating to AI systems decision-making processes such as the suitability of candidates for a job position, ac-

1. In 2020, Gebru was terminated from her job because she refused to retract the findings published in an academic paper after her superiors requested it. The referred paper explained the weaknesses of facial recognition and evidenced a 34% error margin in recognizing black women. More information in Pérez, 2020, and Hao, 2020. Mitchell was terminated months later. She is considered one of the leading experts in ethics applied to technology and one of the 100 most influential people of 2023 (Catá, 2023).

cessing life insurance or mortgages, the resolution of administrative applications, etc., offers public managers the necessary ethical distance to make decisions that are increasing the vulnerability, inequality and exclusion of the more disadvantaged people. Whether or not they belong to the statistically relevant, or reference, profiles identified by AI models, algorithms and systems, can mean the difference between being eligible or not to be a beneficiary of all the resources that a society puts into circulation to facilitate the lives of citizens. The line between classification based on algorithmic calculation (apparently objective) and the assessment of the specific conditions of cases that require human deliberation, reflection, rationality and communication is not so thin if it involves increasing the vulnerability and social exclusion of these people.

Of particular concern is the advance of generative AIs in those areas that reflect human skills, rationality and creativity: artistic and creative works, those requiring conceptual analysis and critical thinking, and those of knowledge transfer and shaping, as well as the teaching and learning process of new generations.

4.4. From Externalized Memory to Fractured Thinking

It would not be wrong to say that we have left behind the era of knowledge embodied in books with structured discourses and careful arguments. Now, we are in the fragmentation of thought. Rationality also requires time. That time no longer exists in the face of the continuous acceleration of processes. AI does not reason, it computes. Arguments can be improved and are the basis of continuous learning, especially in the formative stages; however, if we replace them with algorithms, even if they are optimized, this leads us to abandon the argumentative and reflective effort. This is, at the same time, an abandonment of thinking. We cannot process the enormous amount of information, nor fight against the speed of tweets, memes or the attractiveness of images that impact our brain, turning it into a true addiction to the continuous consumption of visual stimuli that impact our emotionality instantaneously.

> Big data and Artificial Intelligence enable the information regime to influence our behavior at a level that lies below the threshold of consciousness. The information regime takes hold of those pre-reflexive, instinctual, emotive layers of behavior that precede conscious actions. Its data-driven psychopolitics intervenes in our behavior without us being aware of it. (Byung-Chul Han, 2022, p. 15)

However, we are forced to think about and implement, in the teaching-learning process, new strategies that make use of the best of generative AI systems: especially those that process natural language and image creation, among others. We must incorporate generative AI systems and, at the same time, stimulate and enhance reflection, rational argumentation and meaningful learning. Rational-argumentative and meaningful learning are the basis for growth and development in the personal growth of the younger generations. This is essential for a mature and deliberative citizenship. Moreover, it is the basis for a well-functioning democratic society. Hannah Arendt was already pessimistic in the 1990s, but we are still obliged to make this effort.

> The effort of knowledge and perception is replaced with the business of distraction. The consequence is a rapid decline in human judgment. There is an unmistakable threat in it: it either makes the public immature or keeps them immature, and it touches on the social basis of democracy. We had fun until we died. (Hannah Arendt, 1996, p. 342, self-translation)

Education is constantly evolving, and the direct influence of technological advances at all levels has long been watched with concern. The widespread use of the Internet facilitated many tasks of searching for information, allowed communication in new formats and put into circulation all kinds of resources that have been changing the scenario and the patterns of the teaching-learning process. Adapting and incorporating new methodologies and evaluation systems has been a constant in recent years. Nevertheless, it is undeniable that the impact of AI systems on education poses a new challenge, especially Natural Language Generation models such as the one developed by Open AI (ChatGPT), and others like it. These systems can generate study materials, offer conceptual precisions when required,

bodies of structured information, explanations on a topic, solutions to mathematical problems, and so on. From this point of view, they can become learning partners, tutors who guide the process of self-learning or help in educational management.[2] At the same time, we easily delegate to this types of tools the effort of writing well-structured texts with personal involvement; we subrogate the act of formal teaching, which is considered an act of social interaction essential in the development of the human being and with a high load of emotional capital (Tarabini, 2020) provided by the presence of the teacher, particularly in the first years of life.

On the other hand, teachers can also generate materials and obtain answers to numerous questions about the best way to organize their educational and assessment practice, among other tasks. There is the option to perform an automated assessment and to know in real time the performance and progress of the students. The question immediately arises as to the authenticity of the learning and assessment process: does this develop an adequate level of critical, argumentative and communicative skills? Moreover, do we learn to differentiate correct, truthful or relevant information from that which is not? And do they develop the capacity for independent thinking or do they get used to quick and limited answers to save the delivery of a paper or the preparation of an exam or assignment? In addition, the use of these tools produces a loss of the value of authorship, as they do not consider the citation process relevant and the concept of plagiarism is relativized.[3]

As teachers, we are also concerned about the loss of the ability to concentrate, loss of the ability to argue and to make well-founded judgments, loss of creative, deliberative and communicative skills. We observe with concern the fragmentation of attention and thought, which are fundamental values for becoming

2. In the field of management, the Lola (University of Murcia, 2028) or ADA cases of (University of Jaén, 2021) are pioneering examples that have implemented AI-based virtual assistants. With a chatbot, they have provided information for new students and have helped to resolve doubts about degrees, credits and procedures.

3. In a recent study on dishonest practices among students in the first year of the Bachelor's Degree in Primary Education, 40% of students perceive that the practice of plagiarism in academic tasks is common despite the fact that they also recognize that if it is proven has serious consequences for their academic performance (Sánchez-Vera et al., 2023).

good professionals in the future and having an adequate personal development. Acting ethically means being able to take responsibility for our judgments and actions and their consequences, something that machines cannot do, no matter how sophisticated they become.

4.5. Regulation of Artificial Intelligence and the Future of Democracies

The conflicts of values and the problem of many things (*numerous interconnected scientific and technical elements*) and too many hands (*many* agents, with different objectives and values, at different levels), such as AI systems (Coeckelbergh, 2021, p. 98-99), challenge the issue of responsibility and reliability in a techno-science whose problems of opacity, lack of transparency, and explainability demand the necessary limitation through regulation. The EU has recognized this for years when it formed the specific commission that developed the AI White Paper published in 2020. It states: "Given the major impact that AI can have on our society and the need to build trust, it is vital that European AI is grounded in our values and fundamental rights such as human dignity and privacy protection" (p.2). Moreover, the requirements for trustworthy AI are seven: human action and oversight; technical soundness and safety; privacy and data management; transparency; diversity, non-discrimination and equity; social and environmental well-being and accountability. With a risk-based approach that grads these systems from unacceptable risk, high risk, limited risk and minimal risk, on December 9, 2023, an agreement was reached between the Member States and the European Parliament and, although it must be ratified, the text defines the obligations and rules by which this technology must be governed. Europe will only allow the use of facial recognition and biometric control systems in special cases and with judicial authorization. Regarding generative or foundational models such as ChatGPT, these will have to meet transparency criteria and it will be necessary to clarify whether a text, an image, or a song has been generated by AI. In addition, it must be ensured that the data that have been used respects copyright. The

law will not be available for at least three years, but the European initiative undoubtedly sets limits to these developments so as not to jeopardize the rights and values that we consider central to democratic societies.

4.6. Artificial Intelligence and the Future of Education

The expansion of digital technologies in the last decades and recent advances in generative Artificial Intelligence are shaking traditional pedagogical models. The traditional educational approach, rooted in books and structured arguments, is compromised in the face of new scenarios of fragmented and accelerated thinking due to the efficiency of digital technologies and generative AI.

We should carefully consider the role of algorithms in educational processes, as AI computes and optimizes, but humans deliberate and reason. AI systems can give logical arguments, but they do not possess the faculty of reasoning in the human sense (Larson, 2022). In education, the opportunity to integrate AI is yet to be determined, that is, it is necessary to establish what, how and when to use technology, otherwise we can fall into dependence on algorithms and affect the critical, argumentative and communicative skills of students. The ability to reason and argue, which is essential for meaningful learning, cannot be relegated to the background by being replaced with technological assistants that, in pursuit of efficiency, strip us of fundamental skills.

In this scenario, we must be aware of the risks of over-relying on automated technology in educational contexts. The promise that technology will provide a more accessible and personalized education, with fair and efficient assessments, and data analysis for informed decisions, is undoubtedly attractive. However, the challenges posed by AI in terms of digital divide, data privacy and security, lack of transparency, and the incorporation of biases into algorithms, require careful thought and action. In addition, excessive automation could lead to a loss of human interaction essential for social and emotional learning (Sánchez-Vera,

2022). At this point, the role and training of educators becomes essential to manage integration and change.

In a world where AI is redefining the educational landscape, we must ensure that the democratization and personalization of learning, facilitated by technology, are balanced with the quality and relevance of the education provided. In this sense, following Amartya Sen's view of development as freedom (Sen, 1999), we must underline the importance of empowering people for active and meaningful participation in society, and this implies fostering critical thinking and ethical understanding in students. It is about offering a comprehensive and holistic education that not only focuses on technical skills, but also on the development of broader human capabilities.

Furthermore, considering the impact of technology on the public sphere (Habermas, 1984), it is essential to reflect on the responsibility of algorithmic systems in social and political values. AI has the potential not only to form opinions and wills, but also to shape interactions in a democratic environment. Habermas, while not specifically focusing on AI, provides a useful framework for considering how technology affects public discourse and opinion formation. The emphasis of this author on rational and deliberative communication in the public sphere can be a valuable reference point for evaluating and guiding the development of educational technologies that respect and promote democracy and citizen participation.

Looking to the future, it must be ensured that technology not only advances in terms of efficiency, but also contributes to the development of an informed, critical and ethically engaged citizenry. The incorporation of AI in the field of education represents not only a technological evolution, but also a challenge of political, philosophical and social nature, which demands a multidisciplinary approach to ensure that its application reinforces democratic values and promotes and ensures equitable social development.

4.7. Conclusion

The challenge we face with AI, particularly in education, is served. However, we must not lose sight of the fact that this is

only a tool at the mercy of decision-makers in this or any other area. As at other times in history, when technological evolution is generated, our duty is to remember that adaptation and its use must be the product of deep public deliberation.

Knowledge of reality should not be subrogated to the prevailing algorithm. However, we must humbly acknowledge the efficiency, speed and ability to manage huge amounts of data possessed by digital technologies, intelligent systems, chatbots or any other tool based on Artificial Intelligence. In the words of Duede (2023), we may be dealing with an instrumental epistemology, simply different from the epistemology of experts, but reality should not be reduced to one or the other. In this sense, these are two different categories and perhaps valid for obtaining in-depth knowledge, a key aspect of the teaching and learning process. But there are more categories that ethics reminds us not to forget: minority groups, vulnerable people, and contexts are also fundamental categories of knowledge that cannot and should not be forgotten in the complex reality that permeates AI.

Acknowledgement

This work is fully collaborative and is part of the research project "Vulnerabilidad, precariedad y brechas sociales. ¿Hacia una redefinición de los derechos fundamentales?", PID2020-114718RB-I00, funded by MICIU/AEI/10.13039/501100011033

References

Arendt, H. (1996). *Verdad y política. Entre el pasado y el futuro. Ocho ejercicios sobre la reflexión política*. Península.

Barad, K. (2007). *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University.

Byung-Chul Han (2022). *Infocracy*. Polity.

Catà Figuls, J. (2023, 27 November). Margaret Mitchell: "Las personas a las que más perjudica la inteligencia artificial no deciden sobre su regulación". *El País*, https://elpais.com/tecnologia/2023-11-27/margaret-mitchell-las-personas-a-las-que-mas-perjudica-la-inteligencia-artificial-no-deciden-sobre-su-regulacion.html?ssm=whatsapp_CC

Coeckelbergh, M. (2021). *Ética de la inteligencia artificial*. Cátedra.
Criado Pérez, C. (2019). *Invisible Women: Exposing Data Bias in a World Designed for Men*. Chatto & Windus.
Duede, E. (2022). Instruments, agents, and Artificial Intelligence: novel epistemic categories of reliability. *Synthese*, *200*, 491. doi.org/10.1007/s11229-022-03975-6
Echeverría, J. (2003). *La revolución tecnocientífica*. FCE.
Eubanks, V. (2018). *Automating Inequality: How High-Tech Tools Profile, Police and Punish the Poor*. St. Martin's.
European Commission (2020). *White Paper on Artificial Intelligence. A European approach to excellence and trust*. https://op.europa.eu/es/publication-detail/-/publication/ac957f13-53c6-11ea-aece-01aa75ed71a1
Franssen, M. y Kroes, P. (2009). Sociotechnical Systems. In J. Olsen, S. Pedersen, & V. Hendricks (Eds.). *A Companion to the Philosophy of Technology*. Blackwell.
Habermas, J. (1984). *The Theory of Communicative Action*. Beacon.
Hao, K. (2020). Claves del artículo por el que Google despidió a la líder de ética de IA. *MIT Technology Review*. https://www.technologyreview.es//s/12958/claves-del-articulo-por-el-que-google-despidio-la-lider-de-etica-de-ia
Jasanoff, S. (Ed.) (2004). *States of Knowledge. The Co-production of Science and Social Order*. Routledge.
Jasanoff, S. (2016). *The Ethic of Invention. Technology and The Human Future*. W.W. Norton & Company.
Krishnan, A., Abdilla, A., Jung Moon, A., Affoso Souza, C., Adamson, C., Lach, E., Ghazal, F., Fjel, J., Taylor, J., Havens, J. C., Jayaram, M., Morrow, M., Rizk, N., Ricaurte Quijano, P., Cetin, B., Chatila, R., Dotan, R., Mhlambi, S., Jordan, S., &Rosenstock, S. (2021). *AI Decolonial Manyfesto*. https://many-festo.ai/
Larson, E. J. (2022). El mito de la Inteligencia Artificial. Por qué las máquinas no pueden pensar como nosotros lo hacemos. Shackleton.
Pérez Colomé, J. (2020, 13 December). Por qué el despido de una investigadora negra de Google se ha convertido en un escándalo global. *El País*. https://elpais.com/tecnologia/2020-12-12/por-que-el-despido-de-una-investigadora-negra-de-google-se-ha-convertido-en-un-escandalo-global.html?event_log=go
Ricaurte, P. (2022). Ethics for the majority world: AI and the question of violence at scale. *Media, Culture & Society*, *44*, 726-745. https://doi.org/10.1177/01634437221099612

Sánchez Vera, F., Estévez Cedeño, B., Perdomo Reyes, I., & Lozano Galván, E. (2023). Prácticas académicas deshonestas y desarrollo profesional de los estudiantes de magisterio: análisis de los aspectos emocionales y motivacionales implicados. In Santos Villegas, M. J., Alcalá del Olmo Fernández, M. J., Fernández Cerero, J., & Montenegro Rueda, M. *Desafíos educativos a través de la interdisciplinariedad en la investigación y la innovación.* Dykinson.

Sen, A. (1999). *Development as Freedom.* Oxford University.

Tarabini, A. (2020). ¿Para qué sirve la escuela? Reflexiones sociológicas en tiempos de pandemia global. *Revista de Sociología de la Educación*. https://doi.org/10.7203/RASE.13.2.17135

Terrones R, A. (2021). *Inteligencia artificial responsable. Humanismo tecnológico y ciencia cívica* (doctoral thesis). Universitat de València

Universidad de Jaén (2021, 3 June). La Universidad de Jaén, pionera en poner en marcha asistentes conversacionales de atención al usuario. *Diario Digital*. https://diariodigital.ujaen.es/institucional/la-universidad-de-jaen-pionera-en-poner-en-marcha-asistentes-conversacionales-de

Universidad de Murcia (2018, 5 July). La Universidad de Murcia presenta a Lola, un asistente de inteligencia artificial para ayudar a los nuevos alumnos. *Gabinete de Prensa de la Universidad de Murcia*. https://www.um.es/web/sala-prensa/-/la-universidad-de-murcia-presenta-a-lola-un-asistente-de-inteligencia-artificial-para-ayudar-a-los-nuevos-alumnos

Wacjman, J., & Young, E. (2023). Feminism confronts AI. In J. Browne, S. Cave, E. Drage, & Kerry McInerney (Eds.). *Feminism and AI* (pp. 47-64). Oxford University.

Young, E., Wajcman, J., & Sprejer, L. (2023). Mind the gender gap: inequalities in the emergent professions of Artificial Intelligence (AI) and data science. *New Technology, Work and Employment*, 1-24. https://doi.org/10.1111/ntwe.12278

5

From Theory to Practice with Artificial Intelligence: Experience of Project-based Learning in Higher Education

PhD Arasay Padrón Alvarez
Universidad Internacional de Valencia, Spain
arasay.padron@professor.universidadviu.com
http://orcid.org/0000-0002-2248-7776

PhD Vladimir A. Rosas Meneses
Universidad Nacional de San Agustín de Arequipa, Perú
vrosas@unsa.edu.pe
http://orcid.org/0000-0001-9508-8743

Abstract
Competency-based training focuses both on the development of capabilities, skills and knowledge, as well as on education in values, experiences and attitudes that, when integrated, are aimed at the successful performance of the student. In this sense, active methodologies, particularly project-based learning (PBL), provide an opportunity for students to apply and develop skills in real situations and through teamwork, making use of the potential of the application of information and communication technologies (ICT), such as Artificial Intelligence. In this context, the present study aimed to assess the methodology applied in the experience of project-based learning and Artificial Intelligence in the online training of mechanical engineers. The experience was developed in the degree of Mechanical Engineering at two universities (National University of San Agustín de Arequipa, Perú and the Technological University of Havana, Cuba) in two subjects, respectively: Mathematical logical reasoning and Pedagogy and didactics of higher education. The analysis was carried out based on a set of achievement indicators (pass, fail, dropout and withdrawal), and it allowed for a comparative study between 2022 and 2023 that offers valuable results in the online training process of these students. The methodology used, the analysis carried out and the impact obtained constitute a motivating guide for today's higher education.

Keywords: Artificial Intelligence, project-based, learning.

5.1. Introduction

The constant demand for change, updating and readjustment of the educational process in the face of various contexts and social transformations places competency-based training in a requirement that cannot be postponed, assuming this pedagogical model as the search for a process that places the student at the center of their training through metacognitive strategies and active methodologies, which affect comprehensive training and lead the teacher in the management and guidance of learning. In this way, the primacy of teaching through learning and cognitive transmission through training is finally eliminated in face-to-face, hybrid, and completely online environments (Urday & Deroncele, 2022; Bernardo et al., 2023).

Project Based Learning (PBL), with an important presence in the literature, is historically recognized as a model, approach, strategy, alternative and other nomenclatures, but the most used and the thesis that is assumed is to consider it as an active methodology. Furthermore, it is recognized as one of the most currently used in higher education, especially in the training of engineers (Mitxelena-Hoyos et al. 2021).

Among emerging technologies, Artificial Intelligence (AI) has been worked on for more than 15 years in its integration into the educational process, based on its impact on online training, as well as tools and methodological alternatives in other contexts. In this field, Artificial Intelligence (AI) offers numerous potentialities, among which the search, compilation and analysis of information in exponential figures and in increasingly reduced times stands out, which poses great help for updating the educational process (Ocaña-Fernández et al. 2019; Baek & Doleck, 2023).

In addition to this are the valuable options for personalization, individualization and feedback in the teaching-learning process, as well as its countless tools and alternatives for the development of student autonomy and participation in their training and growth process, both personal and professional, in all educational areas and levels (D'Mello et al., 2017; Rapanta et al., 2021).

In this framework, this study aimed to assess the effectiveness of the methodology applied in the Project Based Learning expe-

rience and the integration of Artificial Intelligence in the online training of mechanical engineers.

5.2. Project Based Learning (PBL)

Project-Based Learning (PBL) is abundantly discussed in the literature, although in a polysemic and diverse way. In some cases it is conceived as a strategy, method, methodology, theory, approach, activity, task, among other terms. In its study, as a common point, its importance and value prevail in the achievement of the student as the center of the process and in its impact on the formation of a group of competencies and values such as leadership, creativity, communication and collaboration. Likewise, its strong relationship is recognized with approaches and theories such as meaningful, cooperative learning, the flipped classroom, and more currently with the integration of information and communication technologies (ICT) (Ayerbe & Perales, 2020; Cyrulies & Schamne, 2021; Zambrano, Hernández, & Mendoza, 2022).

PBL is defended as an active methodology that promotes meaningful learning, by involving students in real and challenging situations that allow them to develop important skills and competencies for their future in the problem-profession-project relationship. PBL is consolidated as one of the methodologies that directly affects the student as the center of the process, where their self-direction is strengthened through self-directed learning (SDL) skills (Loyens, 2008).

Among the particularities of PBL is its practical approach, which focuses on solving real and meaningful problems for students, provoking high levels of creativity and autonomy. Furthermore, the creation of a tangible final product, which implies not only the mastery of the content, but the development of skills, abilities, values and spaces for group interaction that strengthen communication, collaboration, and critical thinking, among others (Villalobos, 2022).

AI can facilitate advanced analytics and tailor learning experiences to individual student needs, taking PBL methodology to a more advanced and adaptive level in the digital age. The combination of PBL, ICT and AI creates a dynamic and student-cen-

tered educational environment, where practical application, autonomy and technology converge to significantly enrich the learning process.

5.3. Artificial Intelligence

The growing impact of Artificial Intelligence (AI) influences the educational process in an accelerated manner and from various sciences, such as Computer Science, Statistics, Psychology, Sociology, and Pedagogy, among others. In this multidisciplinary process, a responsible and pedagogically-based integration is required in the first instance in such a way that it contributes to the strengthening of the training process from its broad potential (Bhargava, 2022; Martínez et al., 2023).

In this incessant but necessary search for resources and alternatives for an educational process where technology and virtuality are considered prevailing, the impact of Artificial Intelligence (AI) has curricular, pedagogical and didactic implications and challenges. In this debate, numerous authors, such as González and Silveira (2022) and Bellomo (2023), highlight its importance for the personalization of the educational process, for support and tutoring, as well as for the prediction and analysis of data and results of the training process. They also underline the growing role of educational approaches, such as smart education and precision education, as well as the emergence of various AI applications and technologies in the field of education, such as learning analytics, intelligent tutoring systems, MOOCs, and virtual teaching-learning (EVEA), all this with important reflections on the necessary basic curricular, pedagogical and didactic conception required by the educational model that is defended.

As AI becomes stronger, at a didactic level, it is more easily integrated into the students' need for more meaningful educational practices, related to their reality and problem solving, as well as facing new challenges that mobilize knowledge, thinking and capabilities, such as values, decision making, feelings and competencies related to leadership, creativity, collaboration and autonomy (Padrón et al., 2022; Álvarez-Álvarez, 2023).

In this order of ideas, important similarities can be observed between the educational demands and the competencies presented with the professional model in the training of engineers, where educational innovation is insisted upon (Rodríguez et al. 2011; Cundulli & Elizabeth, 2023).

5.4. Didactic Proposal Implemented for PBL Through AI in Engineer Training

Various criteria are found in determining the steps or phases and the key questions for the organization and methodological planning of PBL. Among them, they are recognized from 4 phases (choice and motivation, planning, development and evaluation) (Rodríguez & Hernández, n. d.). Other authors describe it in ten steps, such as López, Gómez, & Ramos (2022), which are followed as a reference for the preparation of the proposal. In this case, it is structured systemically, in 8 steps, with a hierarchical and dependency relationship (Figure 5.1).

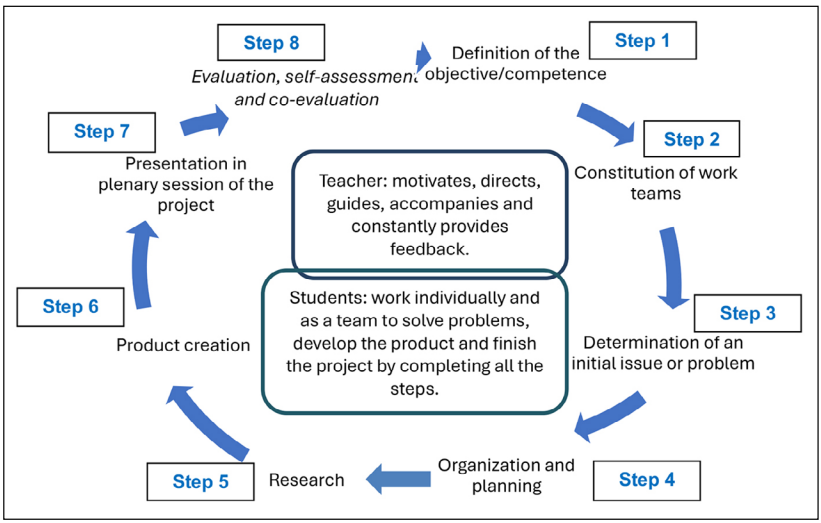


Figure 5.1. Methodological structure for the application of PBL. Source: developed by author.

Methodological guidelines

Step 1. Definition of the objective/competence:

- Identify and develop the objective/competence of the teaching unit. In this case, the integration of several teachers from various careers is suggested to solve the problem from the integration of multidisciplinary teams, thus an integrated work of teachers and subjects that have related topics must be carried out for the development and evaluation of the project.
- Prepare and select numerous resources that enable the student's autonomous study and motivate research on the topic.
- Use learning itineraries, learning routes and/or course maps so that students can select between several tools to study the theory: base document of the subject (Word, PDF), diagrams and infographics (gGnially, Canva, Visme or Animaker), videos prepared by the teacher and links to magazines, and videos selected by the teacher that complement the essence of the subject content.
- Apply techniques for motivation, such as "a picture and a thousand words", "what do I bring and what do I take", among others.

Step 2. Constitution of work teams:

- The teacher determines the essential criteria for forming the teams, including diversity of skills, styles and learning results, technological conditions to avoid the digital divide, particularities of students with SEN and their integration into the team with support.
- Applying techniques for motivation, role distribution and teamwork. Guide and determine by teams the tools and techniques for group collaboration and teacher feedback, synchronously and asynchronously.

Step 3. Determination of an initial issue or problem:

- At this point, the trip to important places related to the professional's field of action is proposed. Application of interviews with teachers and mechanical engineers. The combination of AI with simulation, virtual reality, and augmented reality.

- At the end of this point, each team must identify the problem that they are going to answer with the help and guidance of the teacher. Techniques related to critical or divergent thinking, conflict resolution, environmental changes, among others, can be applied.
- At this time also, the student should be oriented regarding the evaluation, indicators, and levels of achievement; these characteristics and requirements must be evaluated in your presentation.
- Finally, suggest opportunities in this step for students to participate in the planning, execution, and evaluation of the project (instructional co-design and co-creation).

Step 4. Organization and planning: Among the first activities that students must develop in their teams, always with the guidance, accompaniment, and constant feedback of the teacher, are the following: establish your objectives, deadlines, and intermediate and final tasks; distribution of tasks, roles, and responsibilities; identification of necessary resources and collaboration tools; in this step a group of techniques can be used, such as mental maps, the fish diagram (cause/effect), analogical thinking, and list of attributes, among others.

Step 5. Research:

- In this step, it is important that the teacher prepares the student for the research process, offering numerous resources to prepare them for Scientific Research Methodology. Likewise, provide guidance on the tools and resources that the student can use to achieve the expected results.
- Students in their teams must search, collect, process, and manage information. Prepare a theoretical document that bases the product that will be developed to solve the problem. Guidelines should be offered for this part of the work in terms of citations and the standard to be used, structure, format, etc.

Step 6. Product creation:

- The teacher must offer several resources to motivate the students and show articles, tutorial videos, etc., and how to use the tools and create their product with the help of AI, through

different diagrams. In this case, as it is for 4th-year mechanical engineering students, the following resources are offered: AI learning platforms (TensorFlow, PyTorch or scikit-learn); Development kits for robotics (Raspberry Pi or Arduino); Simulation tools (AnyLogic or MATLAB Simulink); Computer-aided design (CAD) libraries (Fusion 360 or SolidWorks); Online collaboration platforms (GitHub); Augmented Reality Tools (ARCore or ARKit); Cloud computing services (Google Colab or AWS Sagemaker); Virtual tutoring platforms (DreamBox Learning) or through the implementation of chatbots (Thinkster Math); collaborative project development platforms (Asana or Trello); Virtual Laboratory Simulators (Labster or ChemCollective); Automatic problem generation tools; Personalized course recommendation systems for the analysis of profiles, preferences, activities, resources, etc.; among many others.

- It is important that students be explained and shown how to respect usage licenses and copyrights, and how to create their own.
- Another aspect to note at this point is the importance of presentations during the creation process. These can be done in team tutorials to assess individualities and resolve the difficulties of each team separately. Several group presentation sessions for collaboration and assessment between teams, promoting peer learning and strengthening team motivation, as well as collective guidance on group difficulties, can also be carried out.

Step 7. Presentation in plenary session of the project: in this step, the teacher's motivation is very important, as well as the application of techniques that mobilize group debate to strengthen critical thinking and creative questioning, which are two fundamental goals in this type of methodology.

Step 8. Evaluation, self-assessment and co-evaluation:

- It is necessary that the teacher shares with the students the indicators, which are instruments and forms of evaluation from the beginning of the process in step 1. The teacher must also maintain personalized and team feedback throughout the process, which allows for the expected progress and the defined objectives.

- The variety of instruments ensures that students are not only evaluated by the product itself, but by the values, capabilities and skills developed in each step of the process, such as, for example, level of creativity, commitment, responsibility, presentation and exposition, research, collaboration, and contributions to other groups, among others.
- It is suggested to apply co-evaluation techniques that allow students to evaluate others. To this end, the teacher must take care of biased judgments, which is why they must carefully select the techniques to use.
- Self-evaluation could be implemented. It is also suggested to apply various techniques and alternatives that enable the exposure of the products to other students of the course, other teachers and students of other courses through contests, exhibitions, etc.
- It is important that the teacher motivates the closure of the project towards the search for new problems and situations that allow the restart of the process and application of the methodology.

The application of PBL, according to these steps, ultimately advocates a cyclical approach that allows restarting again and again, as a new problem arises and a project is organized.

5.5. Methods

Participatory Action Research (PAR) methodology

For this case, Participatory Action Research (PAR) is selected, frequently used for educational and social transformation, which, in turn, coincides with cooperative learning and the search for collective solutions for the common good or purpose towards the construction of new knowledge and the training and development of skills. It is also important to highlight the relevance of orientation and constant feedback from the teacher, who participates during the research process as an active observer.

Participants and context

The research is pre-experimental with a qualitative-quantitative approach, in which an analysis of performance indicators was carried out in two Higher Education Institutions: the National University of San Agustín (UNSA) in Arequipa, Peru, and the Technological University of Havana José Antonio Echeverría (Cujae), Cuba. The subjects selected for this study were Mathematical Logical Reasoning and Pedagogy and Didactics of Higher Education, respectively. As a similarity, the proposal was applied simultaneously in the second cohort of 2023, in the degree of Mechanical Engineering, in the 4th year, and in the modality blended through the Moodle platform. The academic results of these two subjects are compared with those obtained in the previous year, in which the proposal was not applied. Six (6) sessions of coordination and methodological teaching work were carried out for planning, organization and subsequent monitoring of implementation between the two teachers involved. Two of these sessions were conducted face-to-face at UNSA and the rest were performed via video-conference through Google Meet.

5.6. Results and discussion

Quantitative analysis

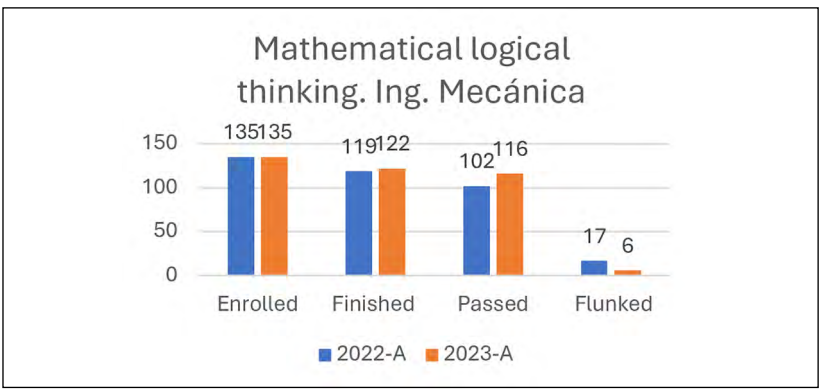


Figure 5.2.A. Results of Mathematical Logical Reasoning subject at UNSA, years 2022 (without application of PBL through AI) and 2023 second cohort (with the application of PBL through AI). Source: developed by author.

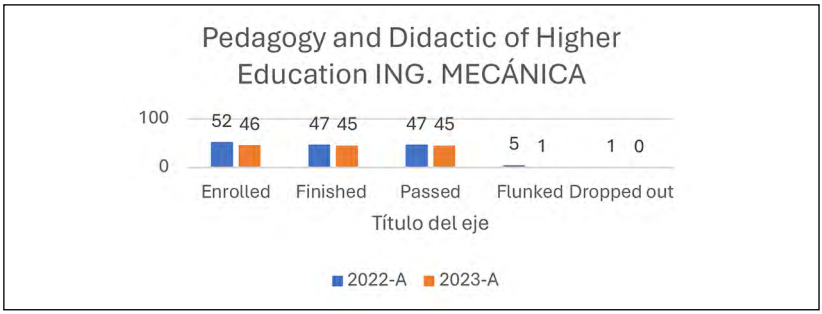


Figure 5.2.B. Results of the Pedagogy and Didactics of Higher Education subject at Cujae, years 2022 (without application of PBL through AI) and 2023 second cohort (with the application of PBL through AI). Source: developed by author.

Qualitative analysis

Students were asked to be part of their own training process, since they participated in the planning, execution and evaluation of the project, following the application of didactic co-design and co-creation (Salido, 2020; Juárez-Pulido, Rasskin-Gutman & Mendo-Lázaro, 2019; Padrón et al., 2022).

Teamwork is essential in PBL, since students must cooperate to achieve the objectives of the project and communicate with each other to share ideas, discuss solutions and make joint decisions, respecting the ideas and opinions of others and demonstrating their own with arguments and evidence (Llorens-Largo et al.,2021; Rua, Henríquez, & Jordán, 2023), all of which is consequently obtained and increases the value of this type of methodology.

The students were involved in solving complex problems that required them to find effective and varied solutions led them to think critically in order to find the best possible solution to a problem and produce the most appropriate product, always with teaching support and collaborative exchange. All this depends on the pedagogical approach that is supported and requires motivation to explore different options. Students were also requested to consider multiple creative solutions, in a motivating and trusting context, so that they could take risks and try new ideas without fear of failure (Llorens-Largo et al., 2021; Albarrán & Díaz, 2021).

PBL through AI contributed to the development of social and emotional skills, which are important for success in personal and professional life to find the timeliest solution, build a prod-

uct and defend it. In this case, it coincides with the reinforcement of empathy, conflict resolution, leadership, commitment and individual and collective responsibility, which are required in these professions (Batistello & Pereira, 2019; Juárez-Pulido, Rasskin-Gutman, & Mendo-Lázaro, 2019).

Finally, in PBL through AI, the evaluation is not limited to an exam or written test, but rather the entire process of the project and product creation is assessed, from planning to the final presentation and group learning, including aspects of the curriculum in the engineering professional model, such as competencies to achieve in a subject, or generally in several subjects that respond to an area of knowledge, and even respond to interdisciplinary relationships (between several disciplines) and much more integrative competencies (Ye-Lin et al., 2019; García et al., 2020).

It is important to recognize in this experience that the importance of data protection, respect for the authorship of products, content and reused resources was taken into account, which the majority of students value as new learning. Likewise, they recognize the value of teamwork as collaborative and, above all, for the values, feelings and new relationships with students from other fields of study and the opportunities that AI offers throughout the research, production and problem-solving process (Aguilar et al., 2023).

5.7. Conclusions

The didactic proposal offered allows us to see significant advances in the final results of the students in the subjects of Mathematical Logical Reasoning and Pedagogy and Didactics of Higher Education, at UNSA and Cujae, respectively. In addition to the achievements that are evident in these students, it is important to highlight that others also benefit from various careers that are part of the experience and are integrated into the projects on their own initiative.

Despite the challenges currently posed by the integration of AI in the educational process, the obtained achievements show an effective path for its application in higher education. In addition to scientifically proven academic results, an important impact is achieved in strengthening values such as responsibility

and solidarity, skills such as creativity and leadership, research skills and feelings of love for the profession. All this significantly increases the value of the proposal that brings, from theory to practice, an experience of project-based learning in higher education using Artificial Intelligence.

References

Aguilar, G. M. F., Gavilanes, D. C. A., Freire, E. M. A., & Quincha, M. L. (2023). Artificial Intelligence and university education: A systematic review. *Magazine of Sciences: Magazine of Research and Innovation, 8*(1), 109-131. https://doi.org/10.33262/rmc.v8i1.2935

Albarrán, F. A., & Díaz, C.H. (2021). Problem-based learning methodologies, projects and case studies in the critical thinking of university students. *Journal of Medical Sciences of Pinar del Río, 25*(3), e5116. http://scielo.sld.cu/scielo.php?pid=S1561-31942021000300013&script=sci_arttext

Álvarez-Álvarez, C., & Falcon, S. (2023). Students' preferences with university teaching practices: analysis of testimonials with Artificial Intelligence. *Education Tech Research Dev., 7*(1), 1709–1724. https://doi.org/10.1007/s11423-023-10239-8

Baek, C., & Doleck, T. (2023). Educational data mining versus learning analytics: A review of publications from 2015 to 2019. *Interactive Learning Environments, 31*(6), 3828-3850. https://www.tandfonline.com/doi/abs/10.1080/10494820.2021.1943689

Batistello, P., & Pereira, A. T. C. (2019). Learning based on competencies and active methodologies: applying gamification. *Scientific Journal of Architecture and Urbanism, 40*(2), 31-42. https://rau.cujae.edu.cu/index.php/revistaau/article/view/536

Bellomo, S. T. (2023). Artificial Intelligence in higher education: An analytical evaluation. *Journal of Ethics in Higher Education, 3*, 87-114. https://jehe.globethics.net/article/view/4626

Bernardo, C. E., Rivera, C. N., Eche, P., & Lizama, V. E. (2023). Metacognitive strategies and autonomous learning in education students at the Universidad Nacional Federico Villarreal. *Horizons. Journal of Research in Educational Sciences, 7*(28), 1002-1012. https://doi.org/10.33996/revistahorizontes.v7i28.570

D'Mello, S., Dieterle, E., & Duckworth, A. (2017). Advanced, analytical, automated (AAA) measurement of engagement during learning.

Educational Psychologist, *52*(2), 104-123. https://pubmed.ncbi.nlm.nih.gov/29038607/

García, V. A., Villaverde, V. A., Benito, V. D., & Muñoz, R. C. (2020). Project-based learning and formative assessment strategies: Perception of university students. *Ibero-American Journal of Educational Evaluation*, *13*(1), 93-110. https://dialnet.unirioja.es/servlet/articulo?codigo=7408493

González, C. S. (2023). El impacto de la inteligencia artificial en la educación. Transformación de la forma de enseñar y de aprender. *Qurriculum*, *36*, 59-60. https://www.researchgate.net/deref/https%3A%2F%2Fdoi.org%2F10.25145%2Fj.qurricul.2023.36.03?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19

Juárez-Pulido, M., Rasskin-Gutman, I., & Mendo-Lázaro, S. (2019). Cooperative Learning, an active methodology for 21st century education: a bibliographic review. *Prisma Social Magazine*, *26*, 200-210. https://revistaprismasocial.es/article/view/2693

Llorens-Largo, F., Villagrá-Arnedo, C., Gallego-Durán, F., & Molina-Carmona, R. (2021). COVID-proof: how project-based learning has withstood confinement. *Virtual Campuses*, *10*(1), 73-88. http://uajournals.com/ojs/index.php/campusvirtuales/article/view/746

López, A., Gómez, C. E., & Ramos, G. (2022). Didactic procedures for the development of learning. *Conrado*, *18*(86), 186-197. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1990-86442022000300186&lng=es&tlng=en

Loyens, S., Magda, J., & Rikers, R. (2008). Self-directed learning in problem based learning and its relationships with self-regulated learning. *Educational Psychology Review*, *20*(4): 411-427. https://doi.org/10.1007/s10648-008-9082-7

Mitxelena-Hoyos, O., Amaro-Mellado, J.L., Martínez-Álvarez, F. (2021). *Use of IT in Project-Based Learning Applied to the Subject Surveying in Civil Engineering*. https://doi.org/10.1007/978-3-030-57799-5_44

Ocaña-Fernández, Y., Valenzuela-Fernández, L. A., & Garro-Aburto, L. L. (2019). Artificial Intelligence and its implications in higher education. *Purposes and Representations*, *7*(2), 536-568. http://dx.doi.org/10.20511/pyr2019.v7n2.274

Padrón, A., Bedregal-Alpaca, N., Rodríguez, J., & Torres, C. (2022). *Design of Didactic Sequences to Strengthen Creativity and Commitment in Online Training*. Dykinson, Casalini. http://digital.casalini.it/9788411225748 - Casalini id: 5336300

Rapanta, C., Botturi, L., Goodyear, P. et al. (2021). Balancing technology, pedagogy and the new normal: Post-pandemic challenges for higher education. *Postdigit Sci. Educ.*, *3*, 715-742. https://doi.org/10.1007/s42438-021-00249-

Rodríguez, M., & Hernández, Z. (s. f.). Project Based Learning (PBL) from the Natural Sciences.

Rodríguez, M. A., Ramos, A. B., González, A. B., Vivar, A. M., Revilla, I., Ausín, T., & Martín, J. F. (2011). *Continuous Evaluation Systems in Engineering Degree Studies*. https://gredos.usal.es/handle/10366/112725

Rua, E., Henríquez, R., & Jordán, I. J. C. (2023). Analysis of project-based learning and collaborative strategies in engineering careers during the COVID-19 pandemic. Case: control theory course I. *Scientific Initiation Magazine*, *9*(1), 55-63. https://doi.org/10.33412/rev-ric.v9.1.3519

Salido, P. V. (2020). *Active Methodologies in Initial Teacher Training: Project Based Learning (PBL) and artistic education*. https://digibug.ugr.es/handle/10481/63803

Urday, J. R., & Deroncele, A. (2022). Meaningful teaching-learning in a virtual educational environment. *Conrado*, *18*(86), 322-331. http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S1990-86442022000300322&lng=es&tlng=pt

Villalobos, M. I. (2022). Project-based Learning Methodology and its Influence on the Development of Soft Skills in Upper Basic Students of the Dr Kind Rosero León (bachelor's thesis). National University of Chimborazo. http://dspace.unach.edu.ec/handle/51000/9704

Ye-Lin, Y., Prats-Boluda, G., García-Casado, J., Estelles, E. G., & Martínez-de-Juan, J. L. (2019). Design, application and assessment of activities aimed at working and evaluating multiple transversal skills in large groups of master 's degrees in engineering, using project-based learning. *Educatio Siglo XXI*, *37*(Nov-Feb), 133-162. https://doi.org/10.6018/educatio.399201

6

The Role of the Faculty Member as an Ethical mentor in the Use of AI in the Academic Field. Ethical perception using ChatGPT in the writing of academic essays

PhD Alazne Ciarra Tejada
Universidad Pública de Navarra, Spain
alazne.ciarra@unavarra.es
https://orcid.org/0009-0000-6320-7437

PhD Diego Ernesto Parra Sánchez
Universidad Pública de Navarra, Spain
diego.parra@unavarra.es
https://orcid.org/0000-0002-5364-1667

Abstract
New technologies for use in the classroom are posing more and more challenges, the repercussions of which are visible both in the academic, personal and social contexts. Tools to assist in academic text writing, such as Grammarly, online translators and ChatGPT, are breaking into the daily teaching life of university students, transforming, to a large extent, not only the process of acquiring knowledge and skills, but also the necessary linguistic abilities for the production of academic essays. This generates concerns in teachers regarding the teaching process (what, how and why to teach), in addition to reflections on the ethical use of AI. Through this research article, it is proposed, on the one hand, to determine the ethical perception of students in relation to its use in the academic field, specifically the use of ChatGPT; and, on the other hand, to reflect on the role of the faculty member in the inclusion of this tool in the teaching-learning process. To this end, a field work was carried out with first-year undergraduate students of the Degree of Teaching and Social Work at the Public University of Navarra (UPNA), Spain. Lastly, this work concludes

with a proposal that provides a teaching performance model for future teachers to manage the impact of AI in the daily classroom.

Keywords: AI, academic writing, ethical use of AI, faculty role, university education.

6.1. Introduction

AI is present in the daily life of any human being today. It is the field of computer science that deals with developing computer tools for data processing in order to perform functions similar to those performed by humans: translating, writing texts, generating solutions, etc.

AI certainly offers benefits, but also risks of misuse or simply erroneous or inaccurate results that must be reviewed by a human being.

Its undeniable arrival in the university environment has sparked a debate among teachers, since more and more students turn to AI as a convenient resource and inexhaustible source of the academic work they must complete and write. The need arises to raise the hypotheses of whether or not it should be included in university programs, if its use is ethical, if faculty members should remake or rethink their teaching role, what use is considered appropriate, what is not, why; what is plagiarism and what is not...

This study aimed to collect the opinions, impressions and evaluations that a group of university students made about the use of AI, specifically ChatGPT, in the academic field, in order to draw conclusions that facilitate a guidance on the consideration of AI in university classrooms and its application in writing academic papers.

In this way, based on the collection of these data, an analysis was carried out and a reflection is offered on the direction that the academic field can and should take for the inclusion of AI in the development of academic writing.

The ethical use of AI for academic purposes

It is clear that AI offers many solutions in the social and professional field, although it is evident that the ethical issue is necessary, since improper use of AI can have negative consequences.

Various philosophers and scholars have brought to light their reflections on the ethical use of AI. Floridi (2023), in his recent work, carried out an interesting analysis of the principles, challenges and opportunities of AI, and offers a reflection on the need to use AI ethically. In the fourth chapter of his recent book, he presents and analyzes five types of bad practices in the use of AI (ethics shopping, ethics bluewashing, ethics lobbying, ethics dumping and ethics shirking). These bad practices pose risks of unethical behavior in the use of AI. The clear solution for this philosopher is knowledge and self-regulation as complements to solid and adequate legislation.

Coeckelbergh (2021) remarks the effects and consequences of a society under the operation of AI where ethical discussion and debate become totally necessary. He demonstrates, with numerous examples, that the results of many AI algorithms offer erroneous solutions and negatively affect society. He questions the privacy of people exposed to AI and other points, such as, moral responsibility in tasks where AI replaces a human being who performed said task, or the question of treatment of AI considering it as if it were a human being.

For his part, Railton (2020) warns of the inevitable presence of AI as an innovative and fundamental technology, but with risks for society, since it questions the ethics of AI itself when it must make decisions that affect human beings, and it does so without any supervision or control by a person. The solution, according to this author, is cooperation between humans and AI without giving full action to AI.

In the university environment, the ethical question is reduced to whether students replace their work with the use of AI or use it as help and support for themselves. The specific question is whether students abandon their learning path, for example, in writing an academic paper, to unethically benefit from the convenience of AI completing the work and the student submitting a paper, without even reading it.

An approach to the university teacher role

In an increasingly digitalized social context and with the increasingly evident introduction of the use of AI in the academic field, it is worth questioning what role the faculty member must play.

Should you change your pedagogy, your methodology? Should you get involved in favoring the use of AI at all costs? Should you reconsider the contents? Should content or only skills be taught? Regarding writing, should a faculty member teach writing in an academic record if an AI can do said work with the same quality as a human being? In that case, what should a faculty member teach in those moments at the university classroom?

"The role of the 21st century teacher, in their pedagogical practice, can be defined as a didactic relationship between personal factors, which occur in the technical, communicative, organizational and relational-affective areas of the teaching-learning process" (Rico and Ponce, 2022, p. 82). These authors also indicate that this definition of the role of the 21st century teacher can, according to Delgado and Viciana (1999) and García, Llorens and Vidal (2024), be considered in the teaching-learning process, on the one hand, in decision-making by the student and, on the other hand, in the selection of the various ways of teaching by the teacher. For Rico and Ponce (2022), the common direction of both considerations must be drawn on the permanent motivation of the students to participate in said teaching-learning process in order to achieve the comprehensive training of the individual. To this question, it is interesting to add the capacities of autonomy, cooperation and critical thinking that provide responsibility and analysis to the proposal given above.

6.2. AI Use and Ethical Perception: A Study

Objectives

The main goals to be achieved through this study are:

- To know the opinion and impression of university students about the presence, accessibility and use of AI in the academic environment.
- To extract data on the main use of it by the student body in the academic sphere and compared to the personal and family sphere.

- To record and understand the ethical perception of the use of AI in the academic field to draw conclusions of interest that can guide the teaching work in this regard at the university.

Methodology and recipient

To obtain data and responses from students about the use of AI and their perception in the academic field, the survey methodology was applied. The survey is an effective tool for collecting opinions and evaluations that provide reviews with qualitative and quantitative content, which can be expressed in percentage values, to analyze them and draw solid conclusions for a specific study. In this case, the main interest is to know the main uses of AI among students, their ethical perception of it and, specifically, their access and habit of using ChatGPT.

The recipients are university students; specifically, the sample consisted of a group of 40 first-year Social Work students from the Public University of Navarra (UPNA). The survey was carried out in the first semester of the 2023/24 academic year between the months of November and December 2023.

The survey: structure

The designed survey consists of a total of 27 questions of various types: open questions (short answer) and closed questions (rating scale; multiple choice or yes/no response). The questions raised are the following:

Table 6.1. List of issues raised in the survey on the use and ethical perception of AI

	QUESTIONS
00	Define AI in your own words.
0	What do you think should be taught at university about AI in your degree?
1	Where is AI present at your university?
2	What is your opinion about the AI presence at your university?
3	Have you used any type of AI to complete university assignments?
4	How often do you use these AI tools for your university work or assignments?

5	In the cases of having used ChatGPT Was it for a final result? Was it to obtain information? Was it to carry out part of the work? Has it been for all the previous options?
6	Since when do you use ChatGPT?
7	What type of academic questions do you propose to ChatGPT?
8	For what type of tasks do you use ChatGPT?
9	What level of satisfaction has this tool given you with the result of the text obtained in ChatGPT? From 1 (nothing) to 10 (total).
10	What grade did you get in that assignment? Do you consider it a good or bad grade? Why?
11	Do you think that an assignment written entirely by you would obtain...? Equal grade Lower grade Higher grade I do not know. Surely lower grade I imagine that an assignment with this tool would get a better grade, in the end it is a higher intelligence Other I do not know
12	Why would there be a similar or different result?
13	When you submit an academic work done with ChatGPT...? I feel very proud because it is a work done by me. It seems to me that I deliver good work, but I am aware that I have not done it myself.
14	Writing an academic work with ChatGPT is plagiarism. Yes. No.
15	In what contexts or academic uses do you believe that using ChatGPT is not plagiarism?
16	Do you use ChatGPT for family or informal contexts, for example, to write to a family member or friend? Why?
17	Do you have a reading habit? What type of books or texts do you read?
18	Do you have a writing habit? What type of texts do you write? Manually or with the computer?
19	If ChatGPT exists, do you think a university student should learn to write? Why? What types of texts should you know how to write?
20	Do you think an AI has feelings, for example ChatGPT? Should we treat it like a person?
21	Do you think that a text written with ChatGPT is as good as a text written by a person or a writer?
22	What risks do you think there are in using ChatGPT at the university?

23	Do you think that since AI is artificial, for example, ChatGPT, it is ethical to ask any type of question?
24	Taking into account that the responses of ChatGPT are generated with texts previously written by humans and knowing news of complaints from writers, for example, for using their works to feed the chat, do you think that AI, in this case ChatGPT, can write its own texts, never written before, completely new and unique? Why?
25	Do you think ChatGPT will be useful in your job? Give an example.

Source: developed by author.

6.3. Results

Of the surveyed sample, 73% participated. Despite having provided the link by email and through the university platform, and having insisted several times on the encouragement to participate in a study on the use of AI and education, the majority of the students did not participate, verbally alleging in the classroom that, since they did not have positive compensation in the final grade, they did not consider the survey as a useful or necessary exercise and, therefore, did not complete it.

AI impressions

The survey facilitated the recording of the following responses about the impression of AI in the academic environment of the surveyed students.

Regarding the first question about the concept of AI, the students responded with three different definitions reformulated below:

- Set of computer applications that make it easier to write papers or answer any question about daily life
- Computer tool drawn from human creation or other Internet sources
- Computer system that artificially recreates or copies real life

In general, students conceive Artificial Intelligence as a computer tool that takes information from human production to create other content that in turn facilitates the academic and daily lives of human beings.

Regarding the content about it in university educational programs, 20% of students consider that it is not necessary in the university environment to have knowledge of AI, while 80% consider that it is, with the following questions being the most relevant to the content of a course on AI or any course that requires the use of it:

- Dangers and benefits of AI
- Use and management of AI
- Specific uses for the specific degree studies of the surveyed group
- Making a good use of AI

The students also responded to the first question about the presence of AI in the university in a varied way: 20% considered that it is not present; 30% found its presence only in digital tools and devices when carrying out academic work; 10% indicated that AI is only present in ChatGPT; and 60% noticed that AI is present everywhere: screens, class sessions, libraries, mobile phones, bank tellers, etc.

Regarding the opinion of its presence at the university, in the second question, 90% considered that its use is useful, very useful or beneficial, although it is not effective. They also commented that, in most cases, the use made of AI for academic purposes is appropriate by users. Furthermore, they recognized that tools like ChatGPT are of great help, but not for doing a complete assignment, as it entails allowing a machine to replace the student's work and, therefore, "it does not serve as learning if a machine does it for you".

Use of AI

In the third question about admitting the use of AI for some university work, 10% said that they had not used it for this purpose, since they fear that it could be considered plagiarism; 60% stated that they had used it to carry out part of the work or find information about it; and 30% reported having used online AI tools to generate bibliographic citations, obtain ideas to inspire a start of their own work or decorate or complete presentation slides of academic works.

In the following graph, it can be seen that, regarding the fourth question about the frequency of use of AIs, specifically ChatGPT, Grammarly, online translators or other AIs, the students responded that they used some AI (33%), ChatGPT (44%) and online translators (22%).

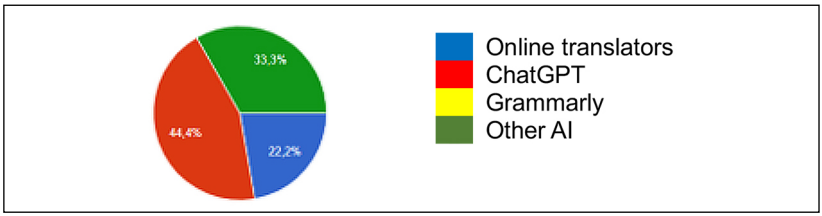


Figure 6.1. Percentages of the frequency of AI tools used in academic works. Question 4. How often do you use these AI tools for your university work or assignments? Source: developed by author based on Google Forms.

The answer to question 5, about how students have used ChatGPT for their academic work, was 90% to make queries and 10% to complete the writing of the work.

Question 6 about the beginning of using ChatGPT indicates that most of the students did not know the specific AI tool of ChatGPT until they reached university. A total of 70% indicated that they did not know it or did not use it, 10% did know it from the previous year (last year of Baccalaureate), while the remaining 20% have known it and used it in the first semester of their degree through their classmates.

The seventh question includes the type of questions that students ask ChatGPT. The majority (70%) stated that they did not ask questions as such to the chat, but instead proposed orders such as requesting summaries, while the remaining 30% indicated that they asked specific questions to obtain specific answers, for example: definitions of scientific concepts in their field of study, e.g., "social cognition", information on a specific topic or the updating of specific data or information.

In the eighth question, about what type of tasks the students use ChatGPT for, 30% answered that they used the chat to write a paragraph or part of the academic work, while 70% answered that they used it for other questions, without specifying which ones.

It is interesting to observe the rating scale generated from the answers to the ninth question regarding the appreciation of the

degree of satisfaction of the result obtained by using ChatGPT: 30% answered without a doubt with a 1, the lowest score; that is, completely unsatisfactory, while the remaining 70% were between a score of 5 and 8, indicating satisfaction, but not full satisfaction.

Question ten regarding the grade obtained in the works delivered with the use of ChatGPT indicates that the majority of the students did not obtain a specific numerical grade, although 30% indicated that the grade was high or very high and good.

Regarding the eleventh question about a self-assessment comparing the final result of a work carried out with ChatGPT and the same one carried out entirely by the student, 60% responded that they did not know if the result would change, while 20% assured that a work carried out by themselves would obtain a lower grade than the one made by ChatGPT; 10% responded that a complete work done using ChatGPT would not only obtain a higher grade, but that the tool is superior to a student's production; another 10% responded that the work can obtain an identical grade whether it is done by ChatGPT or by the student.

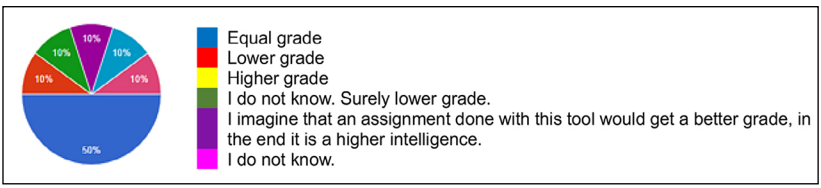


Figure 6.2. Comparison percentages of grade assessment of academic works carried out entirely by ChatGPT or by students. Question 11. Do you think that a work written entirely by you would obtain...? Source: developed by author based on Google Forms

In the twelfth question, regarding the reasons why the results would be different, 70% of the students answered that it would be similar because ChatGPT text serves as a consultation and is not directly transferred to the final text that is delivered; 10% indicated that the result would be better if the work was written by the student because ChatGPT is an AI and, therefore, is not capable of reasoning like a human mind; 20% warned that the text written by ChatGPT would undoubtedly be better because an AI is a superior intelligence or because it simply has a greater amount of knowledge and access to information.

Question number 16 about the use of Chat GPT in everyday life reveals that 100% of students did not use this AI in everyday life because it is not necessary. Questions 17, on reading habits, and 18, on writing habits, show that 50% of the students had a reading habit (novels, scientific texts and books on psychology, i.e., varied readings) and only 30% had a writing habit, manual or with the computer; 70% stated that they did not have any type of writing habit.

Question 19 asked, in this scenario of lack of writing habits, whether it is necessary to learn to write at university and what types of texts; surprisingly, 100% responded that it is necessary to learn to write because it is important, essential and it is necessary to know how to write all types of texts, although they considered that academic texts should be a priority in the university educational curriculum.

Ethical perception of the use of AI

In question 13, about the feeling after submitting an academic work completely written with the use of ChatGPT, 80% responded that they felt confident about submitting a good and quality work, but they are aware that the student has not written it, whereas 20% felt proud and considered that it is their own work, even though they have used an AI like ChatGPT.

In question 14, the same percentage is confirmed again when questioning whether or not the fact of writing an academic work entirely with ChatGPT is plagiarism: 80% clearly answered that yes, it is plagiarism, while 20% assured that it is not plagiarism.

In question 15, the possible contexts where the students (80%) did not consider the use of ChatGPT as plagiarism are the following:

- Information contrast
- Search for information, with subsequent textual reformulation
- Resolution of doubts
- Content learning
- Inspiration of ideas for carrying out academic work

A total of 20% considered that any use is ethical and is not considered plagiarism because it is just a tool and its use is completely legitimate, in any case.

In question 20, about the issue of feelings in ChatGPT and the treatment towards AI, 100% of the students considered that an AI does not have feelings and, therefore, it is not a relevant issue to question how to deal with AI. It is understood and interpreted that, according to the participants, the register used in ChatGPT may be neutral and must not be especially polite nor must any delicate or respectful treatment of feelings be considered, although no specific response was recorded.

In question 21, about the fact of considering a work written by a literary authority as an inferior production compared to that produced by ChatGPT, 10% of the students responded with indecision and doubt about it; 60% clearly responded that a writer produces, without a doubt, better texts, since they are works performed with a human essence and imprint that are irreplaceable by any machine or AI; and 30% responded that it is quite likely that a text written by an AI can be compared to a text produced by a human writer.

In question 22, the students were asked what types of dangers they can discern in the use of ChatGPT for academic purposes: 90% responded that the greatest danger is clearly the accusation or detection of plagiarism, and 10% also pointed out the lack of learning, since the production is not their own and there is no learning process in the creation of the text obtained with AI.

Question 23 addresses the ethical aspect of the point of view of the type of question asked to the AI. A total of 80% responded that they did not know if it is ethical to ask any type of question, while 20% indicated that it is ethical, since it is precisely a tool without feelings and to which you can ask any necessary questions.

Question 24 raises a reflection on the quality and authenticity of the texts generated by an AI, in this case, ChatGPT. The reflection is based on an exercise carried out in class on news regarding the complaints of writers who have discovered unauthorized use of their works to upload textual and registration models to ChatGPT. In this case, 80% of the students believed that the texts are not genuine, since they are based on models written by human beings and, in the case presented, by educated and cultured

writers, while 10% indicated that, although they are not authentic texts, they are unique, because the AI generates new texts from data dumped in its processor, and another 10% considered that ChatGPT generates completely new texts because, despite being based on other texts, the AI has the ability to create completely new and unpublished texts.

In the last question of the survey, about the usefulness of GPTChat or AI in future work, all students (100%) considered the use of ChatGPT useful for text writing issues in a professional context.

6.4. Didactic Proposal for the Ethical Use of AI in Academic Writing

Based on the study carried out and taking into account the considerations collected above about the role that the teacher must play in the current educational scenario, the presence of AI in the teaching-learning process must be considered.

However, the teacher-student dialogue must be supported on an ethical basis that provides solidity to the use and application of AI for the preparation of academic work both in the classroom and outside of it.

The foundations on which a teaching-learning process must be built should consider the use of AI as a didactic tool for consulting data, answering specific scientific questions, requesting registration use models, writing of paragraphs, text structure or examples of appropriate samples of text properties (adequacy, cohesion, coherence and correctness).

In no case, from an ethical perspective, should the complete writing of an academic work be considered for its final delivery, as students do not carry out the writing process, and this is where the lack of learning becomes evident. There is no learning to write where there has not been a writing process. Whether using AI or not, the student must go through a writing process that involves an evolution of the text from the conception of the idea to a final speech that has been transformed, expanded and reduced, evolving in different phases of drafts. It is a development. This is the crucial and most important part of writing an aca-

demic text: its evolution. The student must be aware of the evolution and transformation of their work from the prototype to the final product.

To this end, the faculty member, especially in the first academic year of a university degree, must establish preparation phases, differentiated parts and reference templates for the preparation of an academic work. In this sequencing, the use of AI, for example, ChatGPT, may be included as a consultation tool. However, it will be essential to use examples and perform critical analyses of them to consider the responses of this type of AI, since its results are not always optimal and a review of the writing, registration, content, etc., is necessary. This type of activity can also be an opportunity to develop critical thinking. Under no circumstances should the use of AI be provided or encouraged without the application of a critical filter that nullifies the student's decision-making capacity and leaves all the action in the hands of Artificial Intelligence, nullifying the student's reasoning potential and, likewise, their learning process.

6.5. Final Reflections and Conclusions

It is a reality that AI is present in all areas of today's society and, especially, increasingly in the academic field. Students have easier access to ChatGPT-like tools that they use to answer their questions (not raised in the classroom) or when they lack confidence in their own writing ability.

Many students confess to entrusting the writing of their papers to AI because they doubt their ability to write quality academic texts. They seem disoriented and not able to write using an academic record. The university teacher must provide a planned and structured guide so that the student achieves the necessary strategies for writing their own work. In this matter, the use of AI in an ethical manner is appropriate, that is, as support for the teaching-learning process, but never as a substitute tool that replaces the development of the creation of a text whose final product constitutes an academic work.

Naturally, there are benefits and also dangers in using AI. It will also be the faculty's duty to encourage students to use AI ethically, leaving the final decision to rest with the students

themselves, since it is part of their learning process. Of course, improper use should be considered plagiarism and penalized if detected. Both faculty and students perceive the need to establish an ethical code regarding the presence and access of AI that allows setting agreed limits, while enabling the use of this type of tools to make use of their potential and benefits.

Both the didactic proposal presented in this work and the conclusions drawn represent a suggestion that seeks to invite all teaching teams and Education professionals to reflect and debate the presence of AI in university classrooms.

References

Coehckelbergh, M. (2020). *Ética de la inteligencia artificial*. Cátedra.

Delgado, M. Á., & Viciana, J. (1999). La programación e intervención didáctica en el deporte escolar. Aportaciones de los diferentes estilos de enseñanza. *Apunts. Educación Fisica y Deportes*, *56*, pp. 17-24.

Floridi, L. (2023). *The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities*. Oxford University.

García, F., Llorens, F., &Vidal, J. (2024). La nueva realidad de la educación ante los avances de la inteligencia artificial generativa. *RIED-Revista Iberoamericana de Educación a Distancia, 27*(1), 5.

Railton, P. (2020). *Ethical Learning Natural and Artificial In Ethics of Artificial Intelligence*. Oxford University.

Rico, M. L., &Ponce, A. I. (2022). El docente del siglo XXI. Perspectivas según el rol formative y profesional. *RMMIE*, *27*(92), 77-101.

7

Integrating AI into Academic Research: How We Navigate the Inevitable Ethically

PhD Helen Hendaria Kamandhari
Independent Researcher, Indonesia
kamandharihelen@gmail.com
https://orcid.org/0000-0003-0556-4473

PhD Silvia Lavandera Ponce
Universidad de Ingeniería y Tecnología, Perú
lavandera.silvia@gmail.com
https://orcid.org/0000-0003-4213-4472

PhD Begoña Mora Jaureguialde
Universidad de Huelva, Spain
bego.mora@dedu.uhu.es
https://orcid.org/0000-0002-3559-4318

Abstract
The integration of Artificial Intelligence (AI) in research has brought about a radical change to how knowledge is approached and produced. In higher education research, the use of AI tools, such as ChatGPT, plagiarism detectors, AI document management, and writing assistants, has become widespread. One of the most recent AI tools, i.e., ChatGPT (a chatbot developed by OpenAI and launched on November 30, 2022), has sown discords and stirred divisions among its users. Students and researchers could accomplish their tasks sooner with less effort, thanks to ChatGPT. Both sides could make use of the transformative power and intelligence of ChatGPT to help them generate various contents, such as text, audio, images, synthetic data, or even ask for suggestions. Basically, ChatGPT can serve as our dearest personal assistant, who understands and answers our commands, requests, and questions, to help authors progress at a faster speed, disciplinarily and interdisciplinarily. On the other hand, integrating the use of ChatGPT into research content may not be

recommended due to its conflicting ethical use issues. Thus far, no legal or ethical regulations have emerged to resolve the dynamic intricacies of these situations. However, best practices to overcome the challenges could provide lessons to learn, giving us insights regarding what has been planned and implemented, and what requires more attention and refinement or improvement.

Keywords: academic research, Artificial Intelligence, ChatGPT, ethics, higher education.

7.1. Introduction

Artificial Intelligence (AI) has significantly transformed the way we conduct research in academia. With technological advancement and the availability of massive data, researchers have at their disposal more powerful tools than ever before to analyze, interpret, and generate knowledge. However, this technological revolution poses a number of ethical challenges that must be addressed in a rigorous and reflective manner (Cabanelas, 2019).

In the study, we will explore the ethics in the use of AI in university research. We will also examine the ethical principles that should guide the work of researchers in the field from data collection and analysis to the publication of results. Furthermore, we will discuss case studies and proposals to promote responsible and ethical research practices.

As AI is currently understood, it refers to the development of systems and machines capable of performing tasks that require human intelligence. These tasks include but are not limited to pattern recognition, natural language processing, decision making and problem solving (Cabanelas, 2019; Cortina, 2019, 2022; Government of Spain, 2023).

In university research, AI has been used in a wide range of disciplines, including medicine, biology, engineering, social sciences, and humanities. Some common applications include genomic data analysis, disease prediction, industrial process optimization, text analysis and machine translation (Holmes et al. 2021; Money & Grupo, 2019; Sánchez-García et al., 2023), not to mention the enormous benefits in the personalization of learning that good practices seem to indicate.

On the other hand, some of the AI real-world applications in higher education research that many of us find useful on a daily

basis include but are not limited to plagiarism detection (Ade-Ibijola et al., 2022), AI document management, creation of augmented reality or 3D images, and writing assistants. ChatGPT, which was recently launched on November 30, 2023 (currently ChatGPT 3.5 free version and ChatGPT 4.0 paid version) has especially 'wreaked' havoc on the publication industry. The superability of generative AI chatbot with a Large Language Model (LLM) has been capable of processing tasks based on user prompts (Ahmad et al., 2023). Finally, the consensus in the literature on the need to address the ethical aspect in a standardized manner to avoid collateral damage in the use of these technologies is indisputable.

To date, there has been no evidential clarity whether and how far AI is allowed for use in academic work, projects, or research (Nguyen et al., 2023; Zevedi, 2023). Thus far, no policies have been designed, no regulations have been implemented to resolve any ethically educational issues related to research, no framework has been formulated, and no guidelines have been concluded (Zevedi, 2023). All these are also due to the dynamic nature of AI - which is once again hard to keep up (Zevedi, 2023). However, there are already a multitude of guides, articles and books on how to use these new tools that are revolutionizing the academic world (Craig, 2023). The evidence confirms that AI technology has caused concerns among its users (Stahl B. C., 2021) and challenges, especially in the educational sector (Malik et al., 2023), hence the need for a reflection on the topic.

This study thus sought to address how the use of AI enhances our research and, at the same time, diminishes it in various aspects. In addition, the study provided instances of cases as well as best practices for using AI in research.

7.2. Literature Review

The literature review section highlights the definitions of AI, ChatGPT, and trends, opportunities, and challenges of using AI in academic research areas.

Artificial Intelligence, as Google defines it, is mankind-created systems to perform tasks that need human intelligence, among others, "decision making, visual perception, speech rec-

ognition, and language translation" (Xu et al., 2021; Sethuraman, 2023). In other words, AI can also be defined as the capability of computer-controlled robots which can execute tasks that commonly correlate with intelligent beings (https://www.britannica.com/technology/artificial-intelligence). The respective jargon is used to describe systems development that resembles human intellectual processing: "the ability to reason, discover meaning, generalize, or learn from past experience" (https://www.britannica.com/technology/artificial-intelligence).

It has been evident that AI, especially with the recent ChatGPT, has majorly affected how we perceive, create, use, treat, produce, and reproduce knowledge. It cannot be denied that AI has very essential roles in education (Ahmad et al., 2023). Notwithstanding its essential roles, AI is not immune to ethical concerns and false or erroneous information (Buriak et al., 2023; Whittaker et al., 2018). Ethical issues and concerns (societal implications emanating from the use of AI) include but are not limited to consent issues, data misuse, loss of freedom, and loss of human decision-making power (Stahl, 2021).

To clarify our understanding of AI, we cannot afford not to look at how it started in 1951, when scientists were only trying to make computers be able to play checkers (https://britannicaeducation.com). Yet, basically, AI is not only confined to a concept about robots but also about "understanding the nature of intelligent thought and action using computers as experimental devices" (Buchanan, 2005, p. 54). Then, in the 1930s, as AI was evolving, an exploration into the so-called Machine Intelligence was started by the computer pioneer Alan Turing (Buchanan, 2005).

AI in the real world has been variously applied to different areas, including: education and learning; IoT applications and smart cities; business and finance; social media; virtual reality and assistance; agriculture; healthcare and medical systems; surveillance; travel and transport; entertainment and games; industry; autonomous vehicles; intelligent systems, robotics, and automation; Internet, search engines, and recommendations; cybersecurity and threat intelligence; Natural Language Processing; and computer vision (Sarker, 2022).

Accords and discords have been well recorded in the divisive use of ChatGPT in academic writing or research writing (Frye &

ChatGPT, 2022). Publishing companies have not been able to decide whether authors could have ChatGPT as their co-authors (Frye & ChatGPT, 2022). Several problems that may hinder its realization are whether ChatGPT can be held accountable for any errors contained in the research, and the possession of personal details, such as first name, last name, date of birth, and position, among others. Co-authorship of ChatGPT directly or indirectly could slowly replace human authorship in a project, especially when the human authors eventually rely too heavily on prompting ChatGPT during the writing process, causing the entire ideas to lose originality (Frye & ChatGPT, 2022).

AI has also impacted a comprehensive range of fundamental sciences, including Mathematics, Medical Science, Materials Science, Geoscience, Life Sciences, Physics, and Chemistry (Xu et al., 2021). However, despite the progress, machine learning security risks on data and machine learning models remain as one of the threats. It is essential that machine learning systems that are robust be built to prevent the leakage of sensitive data (Xu et al., 2021).

7.3. Methodology

This study was conducted using a qualitative method of data analysis. More specifically, the study is a conceptual paper where the authors discuss a current theory or phenomenon that has not been fully explained or understood, especially in the case of AI and Academic Research. The research did not have any primary data collection and rather focused on conceptual pieces through connecting existing interdisciplinary theories and generating insightful discussion to eventually challenge our assumptions and expand our worldview (Cropanzano, 2009). This could be achieved by formalizing an idea or a position that has not been addressed before. Thus, a meticulous prior literature review was integrated to yield new conceptualizations or applications (Watts, 2011).

The terminologies of AI, ChatGPT, and AI Ethics are defined in this section to facilitate future researchers and readers in understanding our work and standpoint clearly. In our research, AI is basically defined as:

> the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. (https://www.britannica.com/technology/artificial-intelligence)

ChatGPT, as a product of AI, is

> software that allows a user to ask it questions using conversational, or natural, language. It was released on November 30, 2022, by the American company OpenAI and almost immediately disturbed academics, journalists, and others due to the concern that it was impossible to distinguish human writing from ChatGPT-generated writing. (https://www.britannica.com/technology/ChatGPT)

AI ethics as one of the guiding principles for AI users and the core discussion in the study is "a set of values, principles, and techniques that employ widely accepted standards of right and wrong to guide moral conduct in the development and use of AI technologies" (Rees & Müller, 2023, p. 1241).

7.4. Discussion

Though the ethical principles governing the use of AI cannot keep up with the speed of AI, there are several underlying norms in research ethics that are still considered practicable. One of the most recent AI ethics (Cath et al., 2018; Floridi et al., 2021; Nilsson, 1982) prioritizes transparency and explainability, fairness and equity, privacy, and confidentiality, and eventually, responsibility and accountability.

In terms of transparency and explainability, researchers should strive to make the processes and algorithms used in their research transparent. This involves providing detailed information on how data were collected and processed, as well as how Artificial Intelligence models were trained and validated. Fairness and equity are another set of principles to ensure that Artificial Intelligence algorithms do not perpetuate or amplify existing

biases in the data. Researchers should carefully assess the impact of their research on different social groups and take steps to mitigate potential bias and discrimination. Thus, privacy and confidentiality are the two areas that highlight principles where researchers should respect the privacy and confidentiality of the data used in their research. This involves obtaining informed consent from participants and ensuring that adequate measures are taken to protect sensitive information. Finally, responsibility and accountability principles require that researchers are responsible for decisions and actions taken in the development and application of Artificial Intelligence systems. They should be aware of the potential consequences of their research and be prepared to be accountable for them.

There have been quite a few examples and infinite possibilities of AI application. However, a couple of situations have been selected where an appropriate use of Artificial Intelligence is evident (Hutter, 2004).

In the Case Study of the *Use of Artificial Intelligence in Candidate Selection*, imagine a scenario in which a university uses Artificial Intelligence algorithms to select candidates for its graduate programs. If these algorithms are not properly designed, they could introduce unfair biases into the selection process, discriminating against certain groups of people. To address this problem, researchers must ensure that the algorithms used are fair and equitable. This may involve removing sensitive variables, such as race or gender, from prediction models, and regularly evaluating their performance in terms of fairness.

Data collection has become a crucial step in university research, and it also raises important ethical considerations. Researchers must ensure that they obtain informed consent from participants and respect their privacy and confidentiality. In addition, it is important to consider the potential impact of data collection on the communities and groups involved. For example, in studies involving vulnerable communities, researchers should take additional measures to ensure the protection and well-being of participants.

Following the questions raised, we incorporate a series of proposals for an Ethical Research in AI (Bostrom & Yudkowsky, 2018; Cath, 2018; Zevedi, 2023) that we consider interesting in order not to fall into the temptation of misusing the tools:

- Ethics Training for Researchers. It is essential that researchers receive training in ethics and good practices in the use of Artificial Intelligence. This may include courses and workshops on ethical principles, as well as guidance and advice on the application of these principles in research practice.
- Research Ethics Review. Academic institutions should establish ethics review committees dedicated to evaluating and overseeing research involving the use of AI. These committees can provide guidance and advice to researchers, and ensure that the highest ethical standards are met.
- Transparency, Reproducibility, and Reusability and Research Data Management. Researchers should be committed to transparency and reproducibility in their research. This implies providing access to the data and algorithms used, as well as to the methods and procedures employed in data analysis. Transparency and reproducibility are essential to ensure the integrity and reliability of scientific research. Along with transparency and reproducibility, reusability and research data management should be taken into consideration. Reusability and research data management highlight the importance of the minimum requirement of all archival documentation including AI-specific metadata, ethics applications and votes.

7.5. Conclusion

The speed at which AI has unpredictably progressed exceeds the speed of our ethical institutions in regulating what has been created out of Artificial Intelligence (González-Esteban & Calvo, 2022). Ethics in the use of Artificial Intelligence in university research is a vitally important issue that must be addressed in a rigorous and thoughtful manner. Researchers must adhere to fundamental ethical principles, such as transparency, fairness, privacy, and accountability, at all stages of their work. In addition, concrete measures, such as ethics training, ethical review of research, and promotion of transparency and reproducibility, need to be implemented to ensure that Artificial Intelligence research is conducted in an ethical and responsible manner. Only in this way will we be able to make use of its potential without losing the identity of the researcher.

As Cortina (2022) explains,

> the prestige of science is linked to its capacity for verification or falsification, within the framework of possible experience. Attempting to gain that prestige and credibility with statements that far exceed the possibility of actual or possible corroboration, pretending that they are scientific, is a blatant deception, which goes against the goal of science, against its most basic ethos. A scientific utopia is simply a deception. (p. 473)

7.6. Recommendations for Best Practices

The position that prevails in the literature shows a consensus on the need to unify initiatives for the ethical use of AI (Nodals, 2020). For this reason, we find good practices and attempts to structure guidelines that guide the development of an ethical and responsible use of these technologies in science, society, and technology. However, these practices are presented in isolation and detached from the regulatory part. Piedra Alegría (2022) presents 2 proposals on how the problems arising from the implementation of AI should be addressed.

The first proposal highlights a hard regulatory approach (hard law) that seeks the creation of a legal framework that addresses the creation of clear rules, laws or regulations that define the action framework for AI. Some examples of good practices in this regard are the Chinese AI proposal of the year 2017 "New Generation Artificial Intelligence Development Plan" (AIDP) and China New Generation Artificial Intelligence Development Report of 2019.

The second proposal discusses a soft approach (soft law), considering recommendations, declarations, and manifestos that serve to generate guidelines. Based on this point of view, the European Parliament (2020) raises the urgency of adopting transparent systems that generate trust to avoid harmful uses. This proposal is adopted by the European Union (i.e., Ethical Guidelines for a trustworthy AI), the United States (i.e., Preparation for the Future of Artificial Intelligence) and Russia (i.e., Кодекс этики в сфере — Ethical Code of AI), to mention some cases (Joy Stone, 2022). The second approach

is currently the most developed and responds to an ethical approach led by specialists in this area and by academics in general. This is mainly due to not having efficient and agreed legal regulations yet.

References

Ade-Ibijola, A., Young, K., Sivparsad, N., & Seforo, M. (2022). Teaching students about plagiarism using a serious game (Plagi-Warfare): Design and evaluation study. *JMIR Serious Games*, *10*(1), e33459. https://doi.org/10.2196/33459

Ahmad, S. F., Han, H., Alam, M.M., Rehmat, M. K., Irshad, M., Arraño-Muñoz, M., & Ariza-Montes, A. (2023). Impact of Artificial Intelligence on human loss in decision making, laziness and safety in education. *Humanit Soc. Sci. Commun.*, *10*(311), 1-14. https://doi.org/10.1057/s41599-023-01787-8

Balel, Y. (2023). The role of Artificial Intelligence in academic paper writing and its potential as a co-author: Letter to the editor. *European Journal of Therapeutics*, *29*(4), 984-985. https://doi.org/10.58600/eurjther1691

Barceló-Ugarte, T., Pérez-Tornero, J. M., & Vila-Fumàs, P. (2021). Ethical challenges in incorporating Artificial Intelligence into newsrooms. In *News Media Innovation Reconsidered: Ethics and Values in a Creative Reconstruction of Journalism* (pp. 138-153). https://doi.org/10.1002/9781119706519.ch9

Bates, T., Cobo, C., Mariño, O., & Wheeler, S. (2020). Can Artificial Intelligence transform higher education? *International Journal of Educational Technology in Higher Education*, *17*, 42 (2020) https://doi.org/10.1186/s41239-020-00218-x

Bleher, H., & Braun, M. (2023). Reflections on putting AI ethics into practice: How three AI ethics approaches conceptualize theory and practice. *Science and Engineering Ethics*, *29*, 1-21. https://doi.org/10.1007/s11948-023-00443-3

Bostrom, N., & Yudkowsky, E. (2018). The ethics of Artificial Intelligence. In *Artificial Intelligence Safety and Security* (pp. 57-69). https://doi.org/10.1201/9781351251389-4

Britannica Education (2023, August 7). AI in Education: Introduction. *Britannica Education*. https://britannicaeducation.com/blog/ai-in-education/#:~:text=The%20History%20of%20AI&text=The%20

first%20AI%20program%20was,teaching%20a%20computer%20to%20checkers.

Buchanan, B. G. (2005). A (very) brief history of Artificial Intelligence. *AI Magazine*, *26*(4), 53. https://doi.org/10.1609/aimag.v26i4.1848

Buriak, J. M., Akinwande, D., Artzi, N., Brinker, C. J., Burrows, C., Chan, W. C. W., Chen C., Chen, X., Chhowalla, M., Chi, L., Chueh, W., Crudden, C. M., Di Carlo, D., Glotzer, S. C., Hersam, M. C., Ho, D., Hu, T. Y., Huang, J., Javey, A., Kamat, P. V., Kim, I., Kotov, N. A., Lee, T. R., Lee, Y. H., Li, Y., Liz-Marzán, L. M., Mulvaney, P., Narang, P., Nordlander, P., Oklu, R., Parak, W. J., Rogach, A. L., Salanne, M., Samorì, P., Schaak, R. E., Schanze, K. S., Sekitani, T., Skrabalak, S., Sood, A. K., Voets, I. K., Wang, S., Wang, S., Wee, A. T. S., & Ye, J. (2023). Best practices for using AI when writing scientific manuscripts: Caution, care, and consideration: creative science depends on it. *ACS Nano*, *17*(5), 4091-4093. https://doi.org/10.1021/acsnano.3c01544

Cabanelas Omil, J. (2019). Inteligencia artificial ¿Dr. Jekyll o Mr. Hyde? *Mercados y Negocios*, *1*(40), 5-22.

Cath, C. (2018). Governing Artificial Intelligence: ethical, legal and technical opportunities and challenges. *Philosophical Transactions of the Royal Society. Mathematical, Physical and Engineering Sciences*, *376*(2133), 20180080.

Cath, C., Wachter, S., Mittelstadt, B., Taddeo, M., & Floridi, L. (2018). Artificial Intelligence and the 'good society': the US, EU, and UK approach. *Science and Engineering Ethics*, *24*, 505-528.

Centre Responsible Digitality (ZEVEDI). (2023). Research Ethics for AI Research Projects: Guidelines to support the work of ethics committees at universities. V. 1.0. Darmstadt.

COPE Council (2021). COPE *Discussion Document: Artificial Intelligence (AI) in Decision Making* (pp. 1-9). https://doi.org/10.24318/9kvAgrnJ

Cortina, A. (2022). Los desafíos éticos del transhumanismo. *Pensamiento. Revista de Investigación e Información Filosófica*, *78*, 471-483. https://doi.org/10.14422/pen.v78.i298.y2022.009

Cortina Orts, A. (2019). Ética de la inteligencia artificial. In *Anales de la Real Academia de Ciencias Morales y Políticas* (pp. 379-394). Ministerio de Justicia.

Craig, D.F. (2023). Computadoras que aprenden. Guía básica para docentes sobre inteligencia artificial en educación. Diego Craig.

Cropanzano, R. (2009). Writing nonempirical articles for *Journal of Management*: General thoughts and suggestions. *Journal of Management*, *35*(6), 1297-1581. https://doi.org/10.1177/0149206309344118

Deranty, J.P., & Corbin, T. (2022). Artificial Intelligence and work: A critical review of recent research from the social sciences. *AI & Soc*. 1-17 https://doi.org/10.1007/s00146-022-01496-x

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Lütge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People. An ethical framework for a good AI society: opportunities, risks, principles, and recommendations. *Minds and Machines*, *28*(4). 689-707. https://doi.org/10.1007/s11023-018-9482-5

Frye, B. L. (2023). Should using an AI text generator to produce academic writing be plagiarism? *Fordham Intellectual Property, Media & Entertainment Law Journal*, *33*, 947-969.

Gilson, L. L., & Goldberg, C. B. (2015). Editors' comment: so, what is a conceptual paper? *Group & Organization Management*, *40*(2), 127-130. https://doi.org/10.1177/1059601115576425

Gobierno de España (2023, April 19). *Qué es la inteligencia artificial. Plan de recuperación, transformación y resiliencia.* Gobierno de España. https://planderecuperacion.gob.es/noticias/que-es-inteligencia-artificial-ia-prtr

González-Esteban, E, & Calvo, P. (2022). Ethically governing Artificial Intelligence in the field of scientific research and innovation. *Heliyon*, *8*(2), 1-9. https://doi.org/10.1016/j.heliyon.2022.e08946

Guan, X., Feng, X., & Islam, A. A. (2023). The dilemma and countermeasures of educational data ethics in the age of intelligence. *Humanit. Soc. Sci. Commun.*, *10*, 138. https://doi.org/10.1057/s41599-023-01633-x

Holmes, W., Hui, Z., Miao, F., & Ronghuai, H. (2021). Inteligencia artificial y educación: guía para las personas a cargo de formular políticas. UNESCO.

Hutter, M. (2004). Universal Artificial Intelligence: Sequential Decisions based on algorithmic probability. Springer Science & Business Media.

Juca-Maldonado, F. (2023). El impacto de la inteligencia artificial en los trabajos académicos y de investigación. *Revista Metropolitana de Ciencias Aplicadas*, *6*(S1), 289-296.

Liebrenz, M., Schleifer, R., Buadze, A., Bhugra, D., & Smith, A. (2023). Generating scholarly content with ChatGPT: ethical challenges for medical publishing. *The Lancet*, *5*(3), E105-E106. https://doi.org/10.1016/S2589-7500(23)00019-5

Malik, A. R., Pratiwi, Y., Andajani, K., Numertayasa, I. W., Suharti, S., Darwis, A., & Marzuki. (2023). Exploring Artificial Intelligence in

academic essay: higher education student's perspective. *International Journal of Educational Research Open, 5*(100296), 1-11. https://doi.org/10.1016/j.ijedro.2023.100296

Mittelstadt, B. (2019). Principles alone cannot guarantee ethical AI. *Nature Machine Intelligence, 1*(11), 501-507. https://doi.org/10.1038/s42256-019-0114-4

Mooney, P., & Grupo, E. T. C. (2019). La insostenible agricultura 4.0: digitalización y poder corporativo en la cadena alimentaria. Grupo ETC

Nguyen, A., Ngo, H.N., Hong, Y., Dang, B., & Nguyen, B. T. (2023). Ethical principles for Artificial Intelligence in education. *Educ. Inf. Technol., 28*, 4221-4241. https://doi.org/10.1007/s10639-022-11316-w

Nilsson, N. J. (1982). *Principles of Artificial Intelligence*. Springer Science & Business Media.

Nodals García, C.L. (2021). Sobre la necesidad de unificación de las iniciativas para un uso ético de la Inteligencia Artificial. *Socialium, 5*(2), 318-334. https://doi.org/10.26490/uncp.sl.2021.5.2.880

OECD. (2023). Artificial Intelligence in Science: Challenges, opportunities and the future of research. OECD.

Piedra Alegría, J. (2022). Descolonizando la "ética de la inteligencia artificial". *Dilemata, 38*, 247-258.

Piedra Alegría, J. (2023). Anotaciones iniciales para una reflexión ética sobre la regulación de la inteligencia artificial en la Unión Europea. *Revista de Derecho, 28*, e3264. https://doi.org/10.22235/rd28.3264

Rees, C., & Müller, B. (2023). All that glitters is not gold: trustworthy and ethical AI principles. *AI Ethics, 3*, 1241-1254. https://doi.org/10.1007/s43681-022-00232-x

Sánchez-García, P., Merayo-Álvarez, N., Calvo-Barbero, C., & Díez-Gracia, A. (2023). Spanish technological development of Artificial Intelligence applied to journalism: companies and tools for documentation, production and distribution of information. *Profesional de la Información, 32*(2), e320208. https://doi.org/10.3145/epi.2023.mar.08

Sarker, I.H. (2022) AI-based modeling: techniques, applications and research issues towards automation, intelligent and smart systems. *SN Computer Science, 3*, 158. https://doi.org/10.1007/s42979-022-01043-x

Sethuraman, K. R. (2023). Best practices for the use of generative Artificial Intelligence for authors, peer reviewers, and editors. *International Journal of Advanced Medical and Health Research, 10*(2), 61-63. http://doi.org/10.4103/ijamr.ijamr_306_23

Special Committee on Artifical Intelligence in a Digital Age (2022, April 5). *Report on Artificial Intelligence in a Digital Age*. European Parliament. https://www.europarl.europa.eu/cmsdata/246872/A9-0088_2022_EN.pdf

Stahl, B.C. (2021). Ethical Issues of AI. In *Artificial Intelligence for a Better Future. An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies* (pp. 35-53). Springer. https://doi.org/10.1007/978-3-030-69978-9_4

Watts, R. E. (2011). Developing a conceptual article for publication in counseling journals. *Journal of Counseling & Development*, *89*(3), 308-312. https://doi.org/10.1002/j.1556-6678.2011.tb00094.x

Whittaker, M., Crawford, K., Dobbe, R., Fried, G., Kaziunas, E., Mathur, V., West, S. M., Richardson, R., Schultz, J., & Schwartz, O. (2018). *AI Now Report 2018*. AI Now Institute. https://ec.europa.eu/futurium/en/system/files/ged/ai_now_2018_report.pdf

Xu, Y., Liu, X., Cao, X., Huang, C., Liu, E., Qian, S., Liu, X., Wu, Y., Dong, F., Qiu, C., Qiu, J., Hua, K., Su, W., Wu, J., Xu, H., Han, Y., Fu, C., Yin, Z., Liu, M., Roepman, R., Dietmann, S., Virta, M., Kengara, F., Zhang, Z., Zhang, L., Zhao, T., Dai, J., Yang, J., Lan, L., Luo, M., Liu, Z., An, T., Zhang, B., He, X., Cong, S., Liu, X., Zhang, W., Lewis, J. P., Tiedje, J. M., Wang, Q., An, Z., Wang, F., Zhang, L., Huang, T., Lu, C., Cai, Z., Wang, F., & Zhang, J. (2021). Artificial Intelligence: a powerful paradigm for scientific research. *The Innovation*, *2*(4), 100179. https://doi.org/10.1016/j.xinn.2021.100179

8

Integrating Generative AI into Analytical Practices in Qualitative Inquiry

PhD María Paz Sandín Esteban
Institut de Recerca en Educació (IREUB), Universitat de Barcelona (UB), Spain
mpsandin@ub.edu
https://orcid.org/0000-0003-1836-6126

PhD Angelina Sánchez Martí
Universitat Autònoma de Barcelona, Spain
angelina.sanchez@uab.cat
https://orcid.org/0000-0002-4719-4688

PhD Ruth Vilà Baños
Institut de Recerca en Educació (IREUB), Universitat de Barcelona (UB), Spain
ruth_vila@ub.edu
https://orcid.org/0000-0003-3768-1105

Abstract
This chapter discusses the use of generative AI for qualitative data analysis, highlighting innovative techniques such as inductive coding, sentiment analysis and opinion mining, applied via ATLAS.ti software. It focuses on presenting how CAQDAS programs have currently expanded their analytical tools by integrating AI and, to exemplify these, the chapter analyses the discourse and policy on Artificial Intelligence and education found in official documents from UNESCO, a recognized international authority in the field. Reports of international forums on AI and education in the last five years were scrutinized, in addition to other relevant UNESCO documents on Artificial Intelligence and ethics, providing an overview of current areas of interest and concern and developments within the international education community. The chapter thus offers guidelines for mastering new qualitative analysis tools using AI by critically integrating these procedures into conventional methods.

Keywords: CAQDAS, education, generative AI tools, qualitative analysis, UNESCO.

8.1. Introduction. Overview of AI-assisted qualitative analysis

The advent of generative AI urges us to address the role it occupies (and can occupy) in educational research (and therefore also among the research community), in order to ensure that the question of epistemology and its relationship with methodology is not, once again, neglected within the educational tradition. Undoubtedly, Artificial Intelligence (AI) has great potential in the field of qualitative research, as it can handle large volumes of data, encompassing both explicit information and the more subtle nuances implicit in discourse. The task of assigning codes to relevant quotations in qualitative analysis, a traditionally laborious analytical exercise even with the support of specialized computer aided qualitative analysis software (CAQDAS), has been considerably simplified with advances in AI, especially in technologies incorporating natural language processing (NLP). Recently, CAQDAS has integrated state-of-the-art AI models, such as OpenAI's GPT, streamlining the coding process and the automatic creation of codes by exploring emerging patterns and producing explanatory insights. An example can be found in ATLAS.ti, a program offering AI tools in beta phase (Lopezosa, Codina, Boté-Vericad, 2023) for automatic open and descriptive coding of textual materials (AI responses in this beta phase may be imprecise or take longer).

This chapter discusses the potentials of two specific AI-based inductive coding tools, namely AI Coding and Intentional AI Coding, and two further applications, i.e., sentiment analysis and opinion mining, whose purpose is to identify and quantify emotions and attitudes in text and to examine word patterns, sentence structures and linguistic contexts. To illustrate this, the chapter shows the practical use of the tools in analyzing official documents and blogs by UNESCO and the United Nations focused on education, ethics and AI. The case study underlines the usefulness of the tools for ensuring rigor and quality in qualitative analyses, aligning analytical processes with research objectives. In this way, the chapter provides a comprehensive understanding of experts' and international organizations' recommendations regarding the integration of AI in

forms of education that set out to advance towards a more sustainable world.

8.2. The Integration of AI in Computer-assisted Qualitative Data Analysis Software (CAQDAS): the potentials of ATLAS.ti

In this section, we examine the possibilities offered by the integration of AI in ATLAS.ti (Sabariego, Vilà, & Sandín, 2014) by briefly analyzing its tools.

AI summaries

This is a faster way to extract crucial information, simplifying qualitative analysis and obtaining summarized information quickly with OpenAI (Figure 8.1).

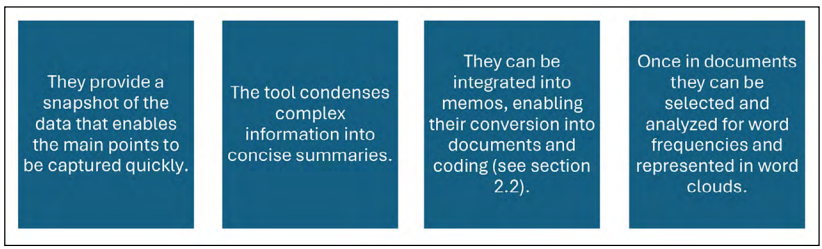


Figure 8.1. Advantages of AI summaries. Source: developed by authors.

AI applications in coding

The applications of AI in encoding documents for analysis are: automated inductive coding (AI coding), intentional coding, and AI-powered code suggestions.

Automated inductive coding: In ATLAS.ti, automated inductive coding, driven by OpenAI GPT models, supports document reading and performs inductive coding automatically. Further review is necessary, of course, in order to refine the automatically generated codes appropriately for the specific study. The suggested process is summarized in Figure 8.2.

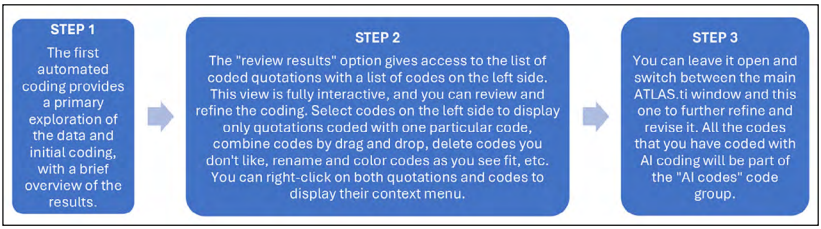


Figure 8.2. *Automated inductive coding process.* Source: developed by authors.

In some cases, GPT models may code for social biases, such as stereotypes or negative feelings towards certain groups, thus careful review of the results is necessary. It is best to submit documents that can combine thematically in the same round of AI coding. Interview questions or participant names in transcripts should be included in their specific response paragraphs. Paragraph structure should be well defined (PDFs can be deficient in this respect). AI Coding skips very short paragraphs, and only parses the plain text of the documents.

Intentional coding: Powered by the technology behind OpenAI's ChatGPT, the AI coding wizard enables us to steer automated coding in the desired direction. It is a tool that allows us to direct AI, obtain codes and explain intentions, concepts of interest and research scope, amongst other features (Figure 8.3).

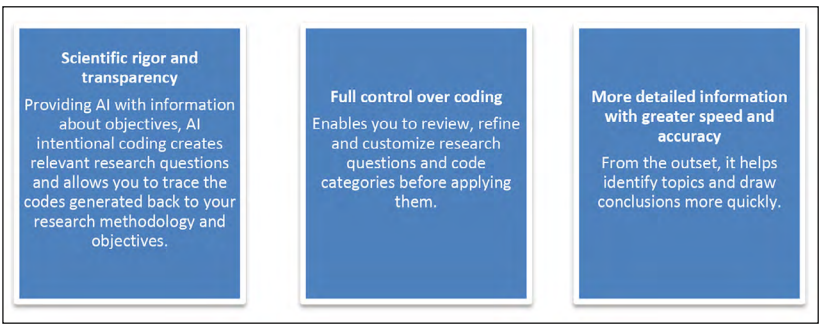


Figure 8.3. *Advantages of intentional coding.* Source: developed by authors.

AI-Powered Code Suggestions: If you prefer to code the data manually and only need a little guidance on how to carry out the coding, the use of suggested codes is recommended. Suggested codes work like AI coding, except that they are applied to a piece

of text rather than to the entire document. All suggested codes should be reviewed while creating your own codes (Figure 8.4).

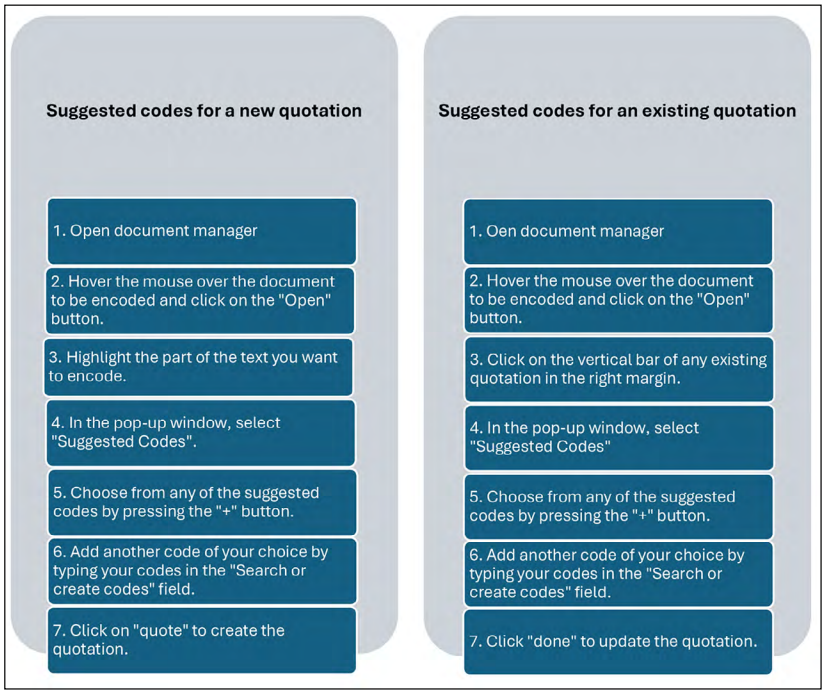


Figure 8.4. AI-powered code suggestions process for new and existing quotations. Source: developed by authors

Conversational AI: chat and interact with documents.

OpenAI's GPT model (used in ChatGPT) utilizes state-of-the-art natural language processing to understand queries contextually, maintain an intelligent dialogue, and provide clarification. Some of the applications of Chatbot AI to qualitative data analysis are shown in Figure 8.5.

AI-assisted sentiment analysis and opinion mining

Sentiment analysis and opinion mining tools are related, but there are fundamental differences in their approaches and objectives. They are often used in tandem to gain a more complete understanding of attitudes and opinions in text analysis, al-

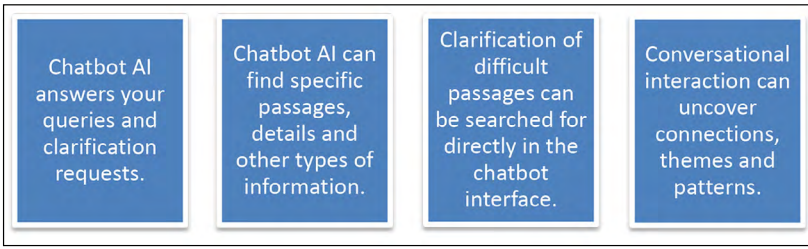


Figure 8.5. Applications of conversational AI to qualitative analysis. Source: developed by authors.

though whether you choose to use them or not depends, as always, on your objectives.

Sentiment analysis focuses specifically on determining the emotional connotations of utterances regarding a topic – i.e., whether the content is positive, neutral or negative – by assessing and quantifying emotional tones, but without delving into more complex aspects of opinion. Opinion mining, on the other hand, enables us to discover and extract opinions and attitudes expressed on a specific topic. Table 8.1 shows some factors that can help researchers decide the best options and the best way to combine them.

Table 8.1. Opinion mining versus sentiment analysis

	OPINION MINING	SENTIMENT ANALYSIS
Definition	Extraction of subjective information from sources such as reviews, comments and opinions expressed in texts.	Focuses specifically on determining the emotional tone of a text, i.e., whether the content is positive, neutral or negative.
Objective	To identify and extract the opinions and attitudes expressed by users on a specific topic.	To evaluate and quantify the emotional tone of the text, without necessarily delving into more complex aspects of the opinion.
Scope	Can cover not only the tone of an opinion (positive, negative, neutral) but also more complex aspects such as the identification of themes, the identification of organizations mentioned and the relationships between different opinions.	Focuses on classifying text into categories of emotional tones and can be part of a broader opinion mining approach.
Applications	For understanding a diverse range of opinions. For deeper analysis.	When tones are sufficient. For simpler applications.

Source: developed by authors.

8.3. Qualitative Analysis Case Study Using Generative AI

The following sections present an example of the use of ATLAS.ti generative AI for inductive coding tools, sentiment analysis and data mining. The case study investigates UNESCO official documents (synthesis reports) on ethics, education and Artificial Intelligence (UNESCO, 2019; 2021; 2022; 2023) and blogs and press releases from both the United Nations (3rd May 2023; 26th July 2023; 7th September 2023; 8th November 2023) and UNESCO (8th June 2023; 16th October 2023), on the same topics.

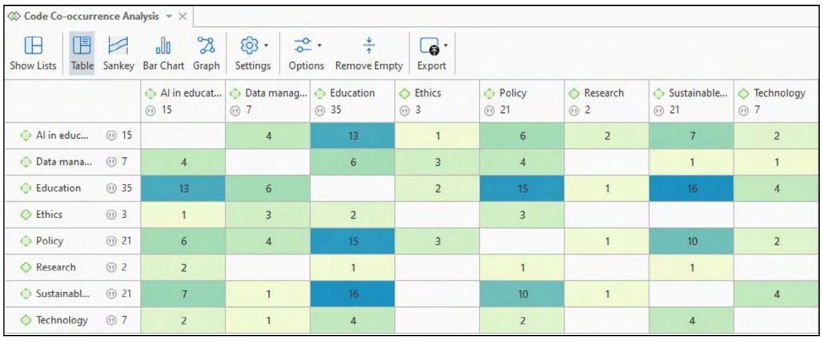
Developing inductive codes and exploratory analysis with assisted AI

The process of applying AI tools to assist in inductive text analysis generally involves three basic steps: induction, organization, andinteraction:

- **Induction**: As noted above, AI-based analysis models read the documents, locate meaningful codes for each data segment and conduct fully inductive coding, presenting an overview of the results. As an example, applying the AI Coding Beta process to the thematic analysis of the report of the Beijing Consensus on AI (UNESCO, 2019), 45 new coded quotations, 145 newly created descriptive codes, the most applied codes (high frequency) and the most co-occurring codes were identified.
- **Organization**: This involves, amongst other things, adjusting the granularity of AI coding results based on your specific needs; eliminating and merging codes; relocating or eliminating quotations; and even discarding codes that, while existing in the quotations, may not be targeted by the study. Thus, in our case, the number of codes was reduced from 145 to 45, following an axial coding process; in the sense, this process of refining the category system sought to discover the most important categories according to: (1) frequency, (2) relevance to the problem statement, and (3) similarities amongst categories. For example, several of the quotations initially in "ed-

ucation" were reassigned to the code "learning"; and quotations from low-frequency codes, such as "learning practices" and "learning outcomes", along with those from codes that were thematically close, such as "personalized learning" or "adaptive learning", were also included in "learning". A further example is that the quotations from "gender equality", "gender gap" and "gender inequality" were added to the code "gender dynamics".

- **Interaction**. Co-occurrence, i.e., when a quotation belongs to more than one code, is the clearest example of relationships and interactions within a data set, and illustrates the richness of qualitative data, which is both complex and multidimensional. AI Coding tells us which topics have the highest co-occurrence of codes. Figure 8.6 shows that, in the case study, these were found at the intersection between "education" and "policy" (15); "education" and "AI in education"; (14) "education" and "sustainable development" (14); "policy" and "AI in education"; (8) and "sustainable development" and "policy" (8).



	AI in educat... 15	Data manag... 7	Education 35	Ethics 3	Policy 21	Research 2	Sustainable... 21	Technology 7
AI in educ... 15		4	13	1	6	2	7	2
Data mana... 7	4		6	3	4		1	1
Education 35	13	6		2	15	1	16	4
Ethics 3	1	3	2		3			
Policy 21	6	4	15	3		1	10	2
Research 2	2		1		1		1	
Sustainabl... 21	7	1	16		10	1		4
Technology 7	2	1	4		2		4	

Figure 8.6. Table of general co-occurrences among codes generated with AI coding in the UNESCO report analysis (2019). Source: developed by authors.

This tool allows us to investigate patterns in the data and suggest hypotheses to deepen the analysis from an exploratory perspective guided by AI automated coding. For example, in Figure 8.7, we extended the analysis window with the details of the subcodes of the association between "sustainable development" and "policy" (8). Thus, we were also able to explore, again by way of example, the relationships between countries' development and governance policies, analyzing the content of the three

corresponding quotes from the Beijing forum document, in which experts stated that effective governance policy is crucial to integrating AI in education, facilitating sustainable development by giving rise to a society that is better equipped to face future challenges. Therefore, this procedure helps us make successive inductive, exploratory and thematic analyses of the co-occurrences of interest with the assistance of AI technology.

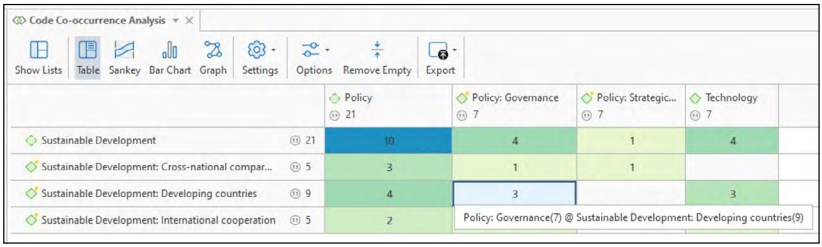


Figure 8.7. Table of specific co-occurrences for the subcodes of "sustainable development" and "policy" (UNESCO, 2019). Source: developed by authors

Another powerful inductive coding tool offered by ATLAS.ti is intentional AI coding, with which we can indicate to the program our individual research objectives in order to guide the AI application and enhance its efficiency. Figure 8.8, for example, shows the input of our research interests and the context of the study, which framed the analysis of the UNESCO forum report (2019) and yielded auto-generated codes.

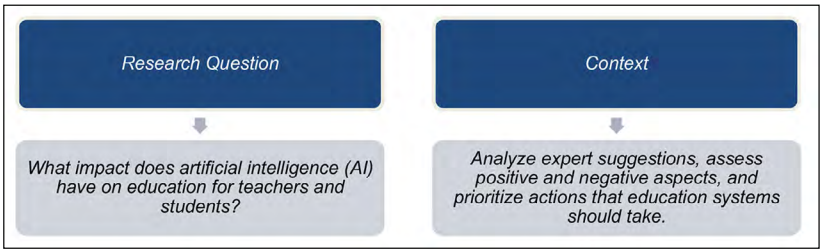


Figure 8.8. Input of intention in ATLAS.ti Intentional AI Coding tool. Source: developed by authors.

The program generated eight questions based on our intention, plus a coding proposal. Before accepting such suggestions, you can add or delete questions and modify codes, thus maintaining control of the coding at all times.

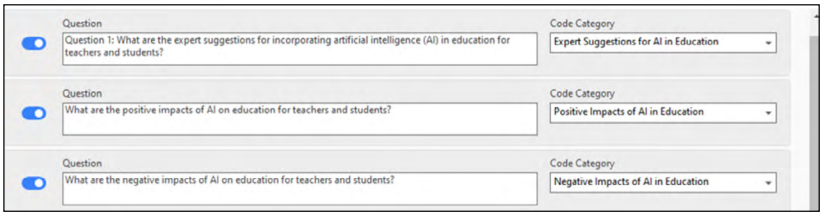


Figure 8.9. Example of questions and code categories proposed for UNESCO (2019), created with intentional IA coding. Source: developed by authors.

With the automatic intentional coding, the result was 121 quotations and 538 codes in eight categories. Again, the analyst's participation in refining the category system offered by AI is important at this point to reduce the number of codes. For example, the codes "ethical concerns", "ethical principles in education" and "ethics" could be subsumed into a single code.

The more context provided for the AI analytical process, the better the results. For example, in our analysis of the four UNESCO documents (2019, 2021, 2022 and 2023), we refined the intention input for intentional AI coding by increasing the number of questions and providing more details about the study, using the instructions below (Figure 8.10). The result was that the location of relevant citations was more accurate and the program provided subcodes with a higher density of quotations (grounded).

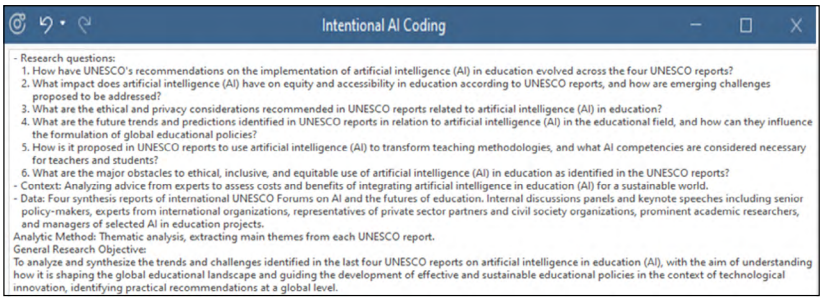


Figure 8.10. Intention in intentional AI coding for analyzing UNESCO forums (2019-2022). Source: developed by authors.

Sentiment analysis and opinion mining

Next, we performed a **sentiment analysis** to obtain an overview of the perceptions and public stance of the United Nations (UN)

and UNESCO – as the UN's specialized agency in the field of education, science and culture – regarding the integration and potential of AI in education, identifying the overall tonality of their publications (positive, neutral or negative) and the areas of interest and/or concern in their discourse.

For this analysis, we selected official documents covering a short period of time, since including a temporal approach in this type of analysis can reveal emerging trends, opinion shifts and increases in the importance of key aspects. Once the documents or groups of documents to be analyzed have been chosen, it only remains to choose the base unit for the search and coding (paragraphs or sentences) and to select the type of sentiment or emotional tone to be coded. ATLAS.ti then suggests subcode labels for each sentiment (positive/neutral/negative), but you can rename them or download and install other more complete models.

The analysis tool searches the documents and presents its results through a quotation reader (Figure 8.11), which suggests a sentiment code associated with a sentence or paragraph and allows you to modify the code if necessary. In this case, the analysis yielded 281 quotations, of which 88 corresponded to positive and negative sentiments. ATLAS.ti offers many possibilities for

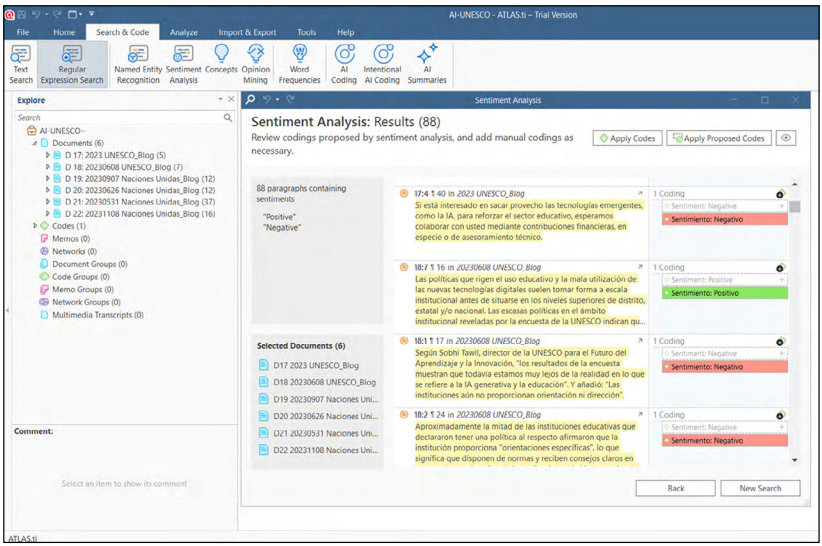


Figure 8.11. Quotations reader after sentiment analysis. Source: developed by authors.

coding. You can, for example, code all the results with one of the suggested codes or with all the suggested codes at the same time. You can also use the regular coding dialog for adding or removing codes.

In this study, we coded all the positive and negative sentiments through a code-by-code review, although automatic coding is also possible. Subsequently, we verified the number of codes identified and assigned colors to each of them in order to make reading clearer and faster, assigning green to positive sentiments and red to negative. In this way, when opening a document, we could see at a glance both the positive and negative sentiments in the compiled news items.

Furthermore, ATLAS.ti enables exploration of the distribution of codes by document, as shown in Figure 8.12. This function was highly useful for exploring the emotional tones in the data – as is usually done when exploring thematic patterns – and interpreting the research results, since it enabled us to visualize the predominance of positive and/or negative feelings in the discourses of the international organizations setting the educational agenda.

To investigate the specific opinions and themes emerging from the positive and negative quotations in more depth, we

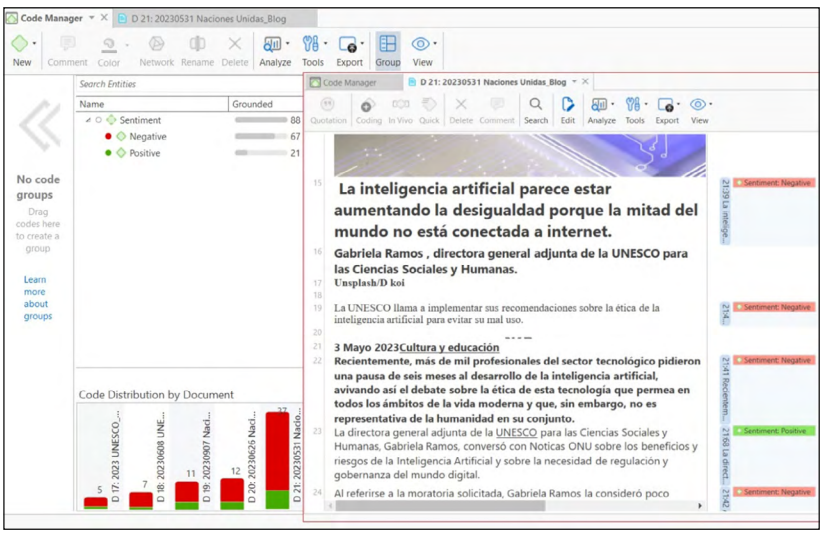


Figure 8.12. Distribution of codes by documents. Source: developed by authors.

used the *opinion mining* tool, which is also extremely useful when combined with a reticular analysis. This qualitative genIA analysis yields a visualization of the most important factors in the positive and negative sentiments, allowing us to review them in context and apply automatic coding.

Opinion mining is a flexible tool that enables analyses on different levels: individual documents, groups of documents, specific codes or sets of codes. Applied to document analysis, it can process one or several documents simultaneously, producing graphs that enable exploration of the results and their text matches.

Once the document or documents have been chosen, ATLAS.ti begins to analyze the data using text analysis algorithms that serve as a starting point for reflecting on the data from different perspectives and theoretical approaches. The aspects detected are displayed in a two-column layout (Figure 8.13): those with positive sentiment in the left column and those with negative in the right. We should also take into account that, since the columns are ordered by the number of occurrences for their respective sentiment, positive and negative results can appear in both columns.

When selecting an aspect, the corresponding text matches are always displayed on the right, and these results can be further

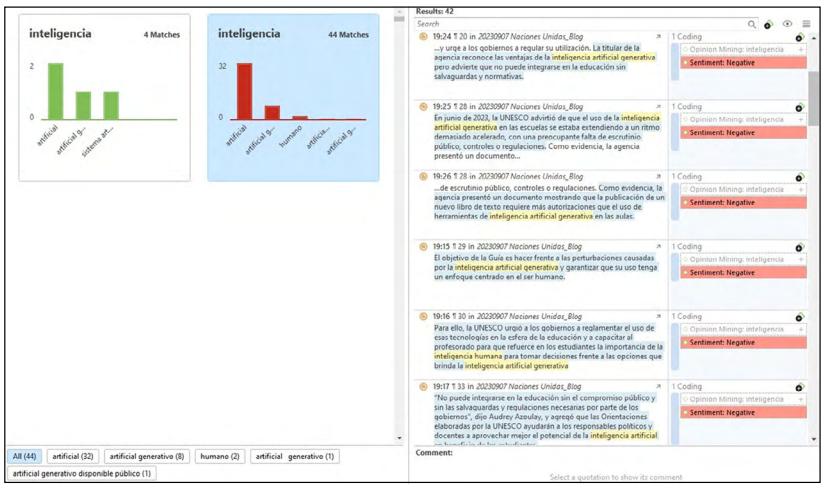


Figure 8.13. AI opinion mining. Source: developed by authors.

filtered by selecting the sentiment modifier themes and coding the text matches progressively. For example, when reading the segments identified as exemplifying a theoretical or descriptive idea of AI, four matches emerged among the positive sentiments. These were references to innovation, diversification and the opening up of possibilities; global collaboration; accelerating the achievement of the SDGs; and efficiency and its associated time savings in research and development. In contrast, among the negative sentiments, 44 coincidences emerged, with references to the challenges and risks associated with AI and its potential unintended consequences, such as a high carbon footprint in model training; ethical issues such as privacy and surveillance; bias and discrimination; security; liability; regulation and supervision; cross-border data flows; unequal data access, and so on. Overall, we found that there was a clear bias towards negative sentiments in the texts, many of which urged UNESCO to focus its discourse on the importance of a consistently human-centered approach in using generative Artificial Intelligence in education, in order to safeguard human rights.

8.4. Critical integration of AI in qualitative analytical approaches

This chapter provides a detailed view of the use of AI in qualitative research, exemplifying its practical application through the analysis of the official discourse of organizations such as UNESCO, which have urged us to pay special attention to the lack of regulation of data use and the ethical issues that we need to address as a society (UNESCO, 2023).

As we have seen, CAQDAS generative AI analytical tools afford advances in line with the most recent and, in many ways, diverse developments in qualitative research. These tools enable us, amongst other aspects, to identify sensitive topics and assess public perceptions (e.g., through sentiment analysis, by detecting topics that generate strong emotional responses; in our case, identifying the international educational community's areas of interest and concern regarding Artificial Intelligence in education); comparison of documents over time (e.g., how percep-

tions and attitudes towards Artificial Intelligence in education have evolved over time, revealing trends, shifts in opinion and factors of increasing importance); and to transform teaching methodologies and AI competencies (e.g., how it is proposed to transform teaching methodologies and what AI competencies are seen as necessary for teachers and students to prepare them for an increasingly technological and automated world).

However, the integration of AI into qualitative analytical methods is still more strongly related to how we as researchers engage with what we seek to investigate, how we go about the process of investigation, and how we make sense of the knowledge we produce, than anything else. In essence, what we argue here is that the adoption of AI involves strategy and method, and that, while such automation may enable us to work faster, our strategies and methods should still be seen as responsive and always appropriate to the data, not as a set of ready-made AI procedures marking out a predetermined route.

There is no point in using AI simply because it is fashionable or just because it is there. In fact, these are precisely the real risks we run if we get too caught up with the ever-increasing range of AI possibilities, since they can be interpreted as an easy route to qualitative research, without really thinking about what they offer the researcher and the particular study at hand. As with any other method, it is necessary to think about the reasons behind our choosing it. As researchers (trainee or otherwise) we need to be aware of the ever-increasing range of possible methods, learn from them and never stop asking ourselves: Why do I want to use this tool? What kind of data or knowledge can this tool or analytical procedure provide in relation to my research objectives? etc.

We should not lose sight of the fact that the process of validation and development in AI analysis is iterative in the same way as more traditional methods. As researchers move forward in an AI-based analysis, they adjust and improve both its analytical capabilities and the coding and analysis system itself, in the light of feedback and accumulated experience. Thus, we would argue that qualitative analysis occurs in the relationship between the researcher and their research, and although AI can help us facilitate the processes involved, in no case may it replace the researcher. No matter the quantity and quality of the automatical-

ly created codes, a researcher should always check their appropriateness.

It is to be expected, for example, that open coding procedures will generate hundreds of codes, single codes will be applied to more than one quotation (hence their large number), and the analyst's refinement of each proposal is therefore essential. The researcher should continue to address the common problems of data quality, such as outliers, information that has no bearing on the research objectives, and the imbalances that often occur in the creation of the category system. It is necessary not to lose sight of how results are generated through AI models and to continue to use constructivist methods – drawn from re-elaboration and abstraction processes – such as constant comparison through open and axial coding (Strauss and Corbin, 2002) or network analyses.

Likewise, it is essential to bear in mind that, despite the advantages offered by these tools, AI models are not infallible and may inherit biases from the data with which they were trained. In addition, human interpretation is necessary to contextualize the results and ensure the validity of the conclusions. Furthermore, before and while disseminating their findings, researchers should ensure that these reflect their specific objectives and conform to scientific rigor. A combination of approaches, using the power of AI together with human research expertise, is still the most effective and ethical way to conduct qualitative analyses.

References

Lopezosa, C., Codina, L., & Boté-Vericad, J.J. (2023). *Testeando ATLAS.ti con OpenAI: hacia un nuevo paradigma para el análisis cualitativo de entrevistas con Inteligencia artificial*. Departamento de Comunicación. Serie DigiDoc. PCUV05/2023

Naciones Unidas (2023, May 3). El debate de la ética de la IA no es tecnológico, sino social. *Noticias Onu*. https://news.un.org/es/interview/2023/05/1520557

Naciones Unidas (2023, July 26). Un informe sobre educación aconseja un uso adecuado de la tecnología en las escuelas. *Noticias Onu*. https://news.un.org/es/story/2023/07/1522972

Naciones Unidas (2023, September 7). Un niño debe tener al menos 13 años para empezar a utilizar la inteligencia artificial en las aulas. *Noticias Onu*. https://news.un.org/es/story/2023/09/1523892

Naciones Unidas (2023, November 8). El poder de la inteligencia artificial y sus desafíos en el marco de las Naciones Unidas. *Centro Regional de Información*. https://unric.org/es/el-debate-de-la-inteligencia-artificial-en-la-onu/

Sabariego, M., Vilà, R., & Sandín, M. P. (2014). El análisis cualitativo de datos con ATLAS.ti. *REIRE. Revista d'Innovació i Recerca en Educació, 7*(2), 119-133, https://raco.cat/index.php/REIRE/article/view/278698.

Strauss, A., & Corbin, J. (2022). *Bases de la investigación cualitativa. Técnicas y procedimientos para desarrollar la teoría fundamentada*. Contus.

UNESCO (2019). Beijing Consensus on Artificial Intelligence and education. Outcome document of the International Conference on Artificial Intelligence and Education. *Planning Education in the AI Era: Lead the Leap*. https://unesdoc.unesco.org/ark:/48223/pf0000368303

UNESCO (2021). International Forum on AI and the Futures of Education. *Developing Competencies for the AI Era*. Synthesis Report. https://unesdoc.unesco.org/ark:/48223/pf0000377251

UNESCO (2022). International Forum on AI and Educatio. *Ensuring AI as a Common Good to Transform Education*. https://unesdoc.unesco.org/ark:/48223/pf0000381226

UNESCO (2023a). International Forum on AI and Education. *Steering AI to Empower Teachers and Transform Teaching*. https://unesdoc.unesco.org/ark:/48223/pf0000386162?locale=en

UNESCO (2023b). *ChatGPT and Artificial Intelligence in Higher Education*. UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000385146

UNESCO (2023c, June 8). Una encuesta de la UNESCO revela que menos del 10% de las escuelas y universidades disponen de orientaciones formales sobre IA. *Centro de Medios*. https://www.unesco.org/es/articles/una-encuesta-de-la-unesco-revela-que-menos-del-10-de-las-escuelas-y-universidades-disponen-de

UNESCO (2023d, October 16). La inteligencia artificial en la educación. *Centro de Medios*. https://www.unesco.org/es/digital-education/artificial-intelligence

9

Redefining Language Education in the AI Era: Challenges, Opportunities and Perspectives

Miguel Cuevas-Alonso
University of Vigo, Spain
miguel.cuevas@uvigo.gal
https://orcid.org/0000-0001-7656-2374

Pablo M. Tagarro
University of the Basque Country, Spain
pablobec93@hotmail.es
https://orcid.org/0009-0003-8220-7792

Abstract
Recent years have seen a substantial evolution in the nascent field of Artificial Intelligence (AI), influencing a wide range of disciplines. The domain of language teaching and learning is similarly undergoing a transformation driven by this technological upheaval, that of Industry 4.0. However, the integration of AI in this field is often undertaken without sufficient reflection, despite the profound social and personal implications it entails, including ethical concerns and data protection issues. The objective of this chapter is, essentially, threefold: 1) it contextualizes language teaching within the burgeoning technological milieu, underscoring the interplay between AI and language education; 2) it explores the challenges and opportunities in language teaching arising from AI integration; and 3) it delves into the potential of AI to enhance the efficiency and effectiveness of language education, while also critically examining the possible adverse effects its application might bring.

Keywords: artificial intelligence, second language acquisition, language education, language learning.

9.1. Introductory Remarks

The emergence of Artificial Intelligence (henceforth AI) within contemporary society has brought with it significant transformations, revolutionising the approach not only to mundane tasks but also to those of a more specialised nature (see, e.g., Russell et al., 2022, for an overview of the field). In this context, numerous scholars acknowledge the advent of what is often referred to as the Fourth Industrial Revolution (or Industry 4.0), a period characterised by the integration of advanced technologies such as AI into sectors like healthcare, finance, transportation, entertainment and the media, human resources and education. Within language education, AI is poised to assume diverse roles in all these fields, serving as a tutor, a learning facilitator, and even an advisor, according to Dakakni & Safa (2023). The potential of AI to mimic human thought processes – such as learning, reasoning, memory, planning and problem-solving – is significant. Combined with its capabilities in voice and image recognition, natural language processing (NLP), and multidimensional factor analysis (Abdullah Sharadgah & Abdulatif Sa'di, 2022), AI is providing substantial (and obvious) benefits in the field of language education. Furthermore, the previous decade has been characterised by an unprecedented developments in deep learning technologies (Surdeanu & Valenzuela-Escárcega, 2024; see also Goodfellow et al., 2016, for a more general review) departing from symbolic approaches to NLP and, by extension, to AI (see Gómez-Pérez, 2023, pp. 57 and ff., for further information). In fact, language-centric AI is "undergoing a paradigm shift with the rise of *neural language models* that are trained on broad data at scale and are adaptable to a wide range of monolingual and multilingual downstream tasks" (Agerri et al., 2023, p. 16, original emphasis).

Nonetheless, for the purpose of proposing the responsible use of these technological advancements, it is crucial to acknowledge that a number of ethical dilemmas are subject to debate. These challenges extend beyond the general implications associated with the use of AI to encompass issues related to language, linguistic policy and the phenomenon of linguistic cybercolonialism. Moreover, the rapid pace of technological advances here scarcely affords adequate time for the execution of comprehensive studies aimed at assessing the benefits and potential risk fac-

tors involved. Consequently, this acceleration brings with it the risk of insufficient understanding of the manner in which these technologies alter various facets of life and human behaviour (Jenks, 2023).

9.2. The Interplay between Language Teaching and AI

The domain of language teaching is one sphere of activity in which AI exerts a considerable influence. As shown in subsequent sections of this chapter, AI facilitates the adoption of innovative methodologies that significantly bolster the learning process, such as gamification (i.e., the application of elements of game design in educational contexts to increase motivation and learning outcomes). Such an enhancement is attributable to four factors in particular (Akgun & Greenhow, 2022; Caldarini et al., 2022; Chen et al., 2020; Dakakni & Safa, 2023; Roll & Wylie, 2016; Wei, 2023; Zhang et al., 2020): 1) the scope for personalised learning,[1] fundamentally through the adaptation of content and pace of learning to accommodate individual requirements, this facilitated by the capacity of AI to identify specific learning difficulties; 2) the adoption of hybrid instructional models, which integrate traditional face-to-face teaching with technologically mediated education; 3) the provision of augmented support for learners engaged in the development of collaborative projects; and 4) the real-time interaction with intelligent systems that can simulate real-life linguistic interaction in natural, realistic contexts, although with difficulties in replicating cultural and contextual nuances (e.g., idioms, colloquialisms, etc.) characteristic of natural languages (Rebolledo-Font-de-la-Vall & González-Araya, 2023).

1. Although findings are not consistent, some studies have shown that AI can sustain the quality of student feedback and intrinsic motivation, and can enhance the efficacy of selfmonitoring in preserving student performance, thus promoting a sense of empowerment in their self-regulated learning practices. Also reported is the possibility that groups trained using AI make additional effort in their peer reviews, resulting in more extended comments; such lengthier comments have been linked to improved learning and selfregulation, and to a reduction in student anxiety (Darvishi et al., 2024; Lai et al., 2023; Wei, 2023). It is crucial, then, to acknowledge the significance of affective states and motivation in the success of language learning performance (Dewaele, 2022).

This is pertinent to the framework of a constructivist approach in the realm of language pedagogy, underpinned as it is by sociocultural theory (Lantolf & Pavlenko, 1995), in the realm of language pedagogy. As argued by Kannan & Munday (2018, 14), "language learning is fundamentally a socio-cultural experience". Concurrently, Blake (2017) observes that collaboration between two or more learners is likely to yield more sophisticated and precise expressions in a foreign language. Furthermore, applying Situated Learning Theory to language acquisition underscores the crucial role of a community, where experienced speakers facilitate the learning process for newcomers. This approach emphasises "the relationship between learning and the social situation in which it occurs" (Lave & Wenger, 2009, p. 14), making clear the importance of contextual and social dimensions in learning processes. At the same time, and as noted by Anderson et al. (1996), we should acknowledge that the situated nature of learning is not a universal requisite for all learning experiences, although it is greatly beneficial in the case of language learning. In this context, it appears that AI could, to a certain extent, fulfill the role of an interlocutor in this form of learning, especially if the process becomes wholly immersive. This, in turn, would have profound effects on the conceptualisation of interaction within language teaching and learning. Moreover, it potentially entails shifts in linguistic behaviour on a global scale (Jenks, 2023).

The ability of AI to simulate real-life situations through multimodal teaching learning is of particular import. To date, achievements have remained elusive, despite efforts to this end within communicative (or interactive-based) and sociocultural methodologies. Yet there is the potential for great success of AI here, moving beyond the era of Computer Assisted Language Learning (CALL) that has been dominant over the past 30 years. It also has the potential to influence and enhance more recent advancements like Mobile Assisted Language Learning (MALL), evolving towards Intelligent CALL and Networked Learning (NL) (Kannan & Munday, 2018). These developments represent a shift towards "learning in which ICT [Information and Communication Technology] is used to promote connections between one learner and other learners, between learners and tutors, and between a learning community and its learning resources" (Jones, 2015, p. 5).

In a similar vein, the integration of virtual reality (VR) alongside AI in language learning should be emphasised. Some studies highlight the benefits that VR can offer in language learning in a variety of ways: the creation of real-life contexts, a reduction in anxiety, etc. (Ma, 2021; Tai & Chen, 2021; Melchor-Couto & Herrera, 2022; Gruber et al., 2023; Kaplan-Rakowski & Gruber, 2023; Ironsi, 2023). In this respect, multimodality (Bateman, 2021; Kress & Van Leeuwen, 2001) currently constitutes the framework within which any language learning should take place, alongside the sociocultural approach (Dressman, 2019; Guo, 2023). Whereas technology applied to language teaching has thus far incorporated this multimodal dimension gradually and to a certain extent (Herrero, 2023), AI could facilitate a substantial improvements here, including the ability to conceptualise communication within the realms of language education and acquisition as transcending mere aggregations of utterances. AI possesses the capacity to analyse and generate messages that incorporate a multiplicity of communicative modalities, engendering a variety of meanings through the use of heterogeneous semiotic resources (including, of course, those of a social nature). This is exemplified by the recent development of Google's multimodal AI model Gemini (Durante et al., 2024), particularly as further progress is made in the transition from multimodal understanding models to multimodal generation models, and with the application of compositional AI. The latter is understood as the use of AI modules with diverse functions that combine to address complex problems, from the amalgamation of which new capabilities emerge, ones which are unattainable for a single module (Du & Kaelbling, 2024; Martie et al., 2023; see also Wei et al., 2022, for emergent abilities of large language models). In addition, the capacity of AI to furnish instantaneous feedback on the progression of linguistic competencies must be underscored, an issue that is of key importance in language learning, given that feedback can propel the learning process (see Chen et al., 2024).

It is thus likely that the use of AI in the years ahead will enable not only the establishment of personalised language-learning programs, but also the reduction of the linguistic gap between what is taught in classrooms and the reality of languages in use. This approach brings students closer to a sociolinguistically im-

mersive reality, by allowing for the consideration and adjustment of content based on the linguistic distance between the macro and micro levels of language use, as well as the cultural, linguistic, and social diversities of linguistic practices.

Within this discourse, several scholarly contributions recommend eclectic methodologies that integrate conventional paradigms with innovative, technology-based methodologies, including AI. Consequently, the synthesis of pedagogical strategies that accentuate the communicative and contextual dimensions of language usage and acquisition – the communicative approach, whole language approach, etc. – seems to facilitate an appropriate means of embedding AI into language education. This integration does not invariably sideline the teacher, and it has been argued convincingly that both blended and situated learning methodologies tend to produce favourable outcomes (Valledor et al., 2023).

As will be discussed below, tools such as intelligent chatbots facilitate language practice in real-world contexts, while adaptive systems tailor content to the user's level, thereby optimising the learning process. AI also contributes to the analysis of linguistic outputs, enabling precise feedback on pronunciation and grammar, and provides learning recommendations based on the user's progress and preferences. This significantly enhances the educational experience and could even alleviate the anxiety associated with foreign language production tasks (Abdullah Sharadgah & Abdulatif Sa'di, 2022).

9.3. AI-Based Technology for Language Learning

AI technologies as applied to language learning scenarios encompass a multi-faceted range of integrations, as described in Pokrivcakova (2019; see also Abdullah Sharadgah & Abdulatif Sa'di, 2022, for the use of AI in English teaching and learning). These range from intelligent tutoring systems (ITS) and chatbots (also conversational agents, virtual assistants or pedagogical agents) (Hwang & Chang, 2023; Zhai & Wibowo, 2022) to speech recognition prototypes. Son et al. (2023), for their part, review AI's role in foreign language learning, highlighting a future where AI-supported tools become integral to language edu-

cation, covering seven areas of application: NLP, data-driven learning, automated writing evaluation, computerised dynamic assessment, intelligent tutoring systems, automatic speech recognition and chatbots.

Gkountara & Prasad (2022), for instance, present an overview of variegated AI implementations within the domain of (foreign) language learning. They outline how AI-based technology can enhance diverse aspects of learning here, such as automated speech recognition (ASR) for pronunciation and oral proficiency training (see Agarwal & Chakraborty, 2019; Liu et al., 2022); the development of tailored syllabuses that adapt to learners' progress; and the use of virtual and augmented reality to gamify learning and promote collaborative learning (see Hung et al., 2018). They also highlight the optimisation of learning applications to accommodate different learning styles (e.g., Duolingo), the evaluation of text readability (e.g., ReaderBench; see Dascalu et al., 2013); the use of AI-powered translation tools (e.g., Google Glass Enterprise Edition or Google Pixel Buds); and automated writing evaluation to improve writing skills, support learner autonomy, and reduce teachers' workload by providing immediate, detailed feedback (see Zhang, 2021, for a review of AWE systems and the importance of navigating challenges such as the effective comprehension of AWE feedback among both educators and learners). Additionally, Gkountara & Prasad (2022) showcase robot-assisted language learning (RALL), as a subfield of human-robot interaction (HRI), for interactive engagement, potentially offering unique advantages over computer-assisted language learning (CALL) (albeit more research is needed to establish robust design and implementation guidelines) (see Randall, 2020), including: the use of AI to mitigate language learning anxiety; personalised feedback through formative assessment with AI and machine learning techniques; and the facilitation of computer mediated communication (CMC) and storytelling (e.g., Mentira, Holden & Sykes, 2012).

9.4. Ethical Considerations

As we know, a substantial number of ethical considerations envelop AI, particularly within its educational applications (Bod-

dington, 2023; Nguyen et al., 2023; Satpute, 2023; UNESCO, 2019, 2021). This chapter focuses exclusively on those aspects which, in relation to language teaching, have specific, significant importance.

Firstly, during the development of individualised learning trajectories, AI constructs models of both learners and educators, incorporating data on their emotional, social, motivational and linguistic states, alongside their preferences within these domains. As indicated in numerous studies, this raises the potential for infringing or compromising privacy (Akgun & Greenhow, 2022) and, among other concerns, it also intersects with issues pertaining to linguistic rights, such as the choice of language and its dialects, for instance.

On the other hand, the challenge of distinguishing between oral/written texts produced by humans or by AI (Farhi et al., 2023; Renzella et al., 2022; Susnjak, 2022; Tlili et al., 2023) represents a recurrent issue in contemporary language teaching in formal contexts. Students often use this technology not to learn languages, but simply to help them pass their courses, possibly because AI is not integrated into classrooms as a supportive tool, but rather is seen as a form of plagiarism (for the time being, largely an undetectable one). Therefore, it is crucial to encourage both educators and students to reflect on the ethical dimensions of using these tools in academic settings, and on the importance of individual linguistic creativity in language learning, without demonising the use of AI-based technologies.

A critical issue to consider in the relationship between AI and language teaching is the status of minority languages in this Fourth Industrial Revolution. A "Digital Language Extinction" would affect not only minority languages but also those which, although of majority use in a specific area, are minority ones in other countries (see Kornai, 2013). This situation has been especially apparent in the field of automatic translation, as noted by Jenks (2023). However, there is also the risk that, within the context of language education, the increased prominence of majority languages, particularly those serving as a lingua franca (i.e., English in the contemporary global context, see Crystal, 2003) and perceived (erroneously) as inherently more valuable, might lead to further marginalisation, if not the effective extinction, of languages with fewer speakers.

This is not a trivial matter, and has led European institutions (Council of Europe Secretariat of the European Charter for Regional or Minority Languages, 2022; European Parliament, 2018) to issue a series of reports aimed at mitigating the precarious situation of numerous languages at risk of digital extinction, in order to fulfill the obligations of the *European Charter for Regional or Minority Languages*.[2] UNESCO has also voiced its concern through various resolutions that seek to promote multilingualism and protect minority languages in the digital domain. In this context, AI can be seen as offering dichotomous potentialities: on the one hand, it offers positive ones, in that it can serve as an invaluable means of collaboration in the development of educational applications targeting the preservation and expansion of those languages in danger, provided that it is aptly designed and trained for such endeavors. On the other designed for and focussed on such ends. On the other hand, there exists a plausible risk that the capabilities of generative AI for these languages might be severely limited due to their underrepresentation in available datasets.

Not all languages enjoy the same levels of technological, social, political and economic supports to ensure their continuance in the AI era, leading to an additional facet of digital colonisation by predominant languages. In their examination of thirty European nations, Rehm & Way (2023, p. 38) point out that "with the exceptions of English, German, French and Spanish, all languages we investigated exist in socio-political and economic ecosystems that do not incentivize, encourage or foster the development of technologies for these languages. While all 30 European countries we surveyed have put in place national AI strategies, almost all of these national strategies seem to have either ignored or left out the topic of languages and language-centric AI".

This consideration is linked to the observation that algorithms are inherently non-neutral, reflecting the values and biases of their creators (Akgun & Greenhow, 2022; Alegria & Yeh, 2023; Karan & Angadi, 2023). Consequently, algorithms may, one way or another, incorporate ideological profiles and biases towards languages, fostering inequality, social stratification and

2. See also the "Report on the state of Language Technology in 2030" (Way et al., 2022) from European Language Equality (2022).

discrimination based on linguistic variables, as well as conforming to specific linguistic policies rooted in social, economic, or strategic interests.[3]

Therefore, it is necessary to incorporate a framework of social justice that also extends to languages and their pedagogy. Such a framework must address and ameliorate inequalities towards ensuring equitable access to technological advances, irrespective of an individual's socioeconomic status. This approach seeks to prevent the exacerbation of the digital divide and the subsequent marginalisation of particular communities, regardless of whether these concerns arise from the status of minority languages or from socioeconomic and political circumstances.

9.5. Conclusion

In the current chapter, we have described both the benefits and the ethical considerations associated with the deployment of AI in the domain of language learning. Clearly, AI has the potential to facilitate the development of tailored learning curricula that not only align with the aspirations of learners but also meticulously track their progression across all linguistic dimensions, ranging from phonetic to pragmatic aspects, and spanning productive, receptive, mediating, and interactive communicative competences, as well as strategic skills. It is crucial to underscore the great capacity of generative AI in developing multimodal environments which, through the integration of VR, will situate learning within a thoroughly immersive experience. However, given the apparent variations in effectiveness across disciplines, a thorough exploration of this issue within the context of language teaching and learning has become essential (Pumptow & Brahm, 2023). The broad benefits of AI may entail certain drawbacks, particularly if there is a lack of awareness regarding the potential consequences that its implementation might have on the use and learning of minority languages. In this context, the need for social justice becomes evident, demanding the elimina-

3. Particularly noteworthy here is the VirtuSign project in terms of its innovative integration of AI, facilitating a gamified environment that enables interactive learning and practice of the American Sign Language (ASL) alphabet (Tukpah et al., 2023).

tion of biases in AI. Such biases can arise from the limited data available for minority languages, as well as from the disparities in access to technology due to socioeconomic factors.

References

Abdullah Sharadgah, T., & Abdulatif Sa'di, R. (2022). A systematic review of research on the use of Artificial Intelligence in English language teaching and learning (2015-2021): What are the current effects? *Journal of Information Technology Education: Research*, *21*, 337-377.

Agarwal, C., & Chakraborty, P. (2019). A review of tools and techniques for computer aided pronunciation training (CAPT) in English. *Education and Information Technologies*, *24*, 3731-3743.

Agerri, R., Agirre, E., Aldabe, I., Aranberri, N., Arriola, J. M., Atutxa, A., Azkune, G., Casillas, A., Estarrona, A., Farwell, A., Goenaga, I., Goikoetxea, J., Gojenola, K., Hernáez, I., Iruskieta, M., Labaka, G., Lopez de Lacalle, O., Navas, E., Oronoz, M., Otegi, A., Pérez, A., Perez de Viñaspre, O., Rigau, G., Sanchez, J., Saratxaga I., & Soroa, A. (2023). State-of-the-art in language technology and language-centric Artificial Intelligence. *European Language Equality*, *D1.2*, 1-65.

Akgun, S., & Greenhow, C. (2022). Artificial Intelligence in education: Addressing ethical challenges in K-12 settings. *AI and Ethics*, *2*, 431-440.

Alegria, S., & Yeh, C. (2023). Machine learning and the reproduction of inequality. *Contexts*, *22*(4), 34-39.

Anderson, J. R., Reder, L. M., & Simon, H. A. (1996). Situated learning and education. *Educational Researcher*, *25*(4), 5-11.

Bateman, J. A. (2021). What are digital media? *Discourse, Context & Media*, *41*, 100502.

Blake, R. J. (2017). Technologies for teaching and learning L2 speaking. In C. A. Chapelle, & S. Sauro (Eds.). *The Handbook of Technology and Second Language Teaching and Learning* (pp. 107-117). Wiley.

Boddington, P. (2023). *AI Ethics: A Textbook*. Springer.

Caldarini, G., Jaf, S., & McGarry, K. (2022). A literature survey of recent advances in chatbots. *Information*, *13*(1), 41.

Chen, B., Bao, L., Zhang, R., Zhang, J., Liu, F., Wang, S., & Li, M. (2024). A multi-strategy computer assisted EFL writing learning system with deep learning incorporated and its effects on learning: A writing feedback perspective. *Journal of Educational Computing Research*, *61*(8), 60-102.

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in education: A review. *IEEE Access*, *8*, 75264-75278.

Council of Europe Secretariat of the European Charter for Regional or Minority Languages. (2022). *Facilitating the Implementation of the European CHARTER for Regional or Minority Languages through Artificial Intelligence*. Council of Europe.

Crystal, D. (2003). *English as a Global Language* (2nd ed.). Cambridge UP.

Dakakni, D., & Safa, N. (2023). Artificial Intelligence in the L2 classroom: Implications and challenges on ethics and equity in higher education. A 21st century Pandora's box. *Computers and Education: Artificial Intelligence*, *5*, 100179.

Darvishi, A., Khosravi, H., Sadiq, S., Gašević, D., & Siemens, G. (2024). Impact of AI assistance on student agency. *Computers & Education*, *210*, 104967.

Dascalu, M., Dessus, P., Trausan-Matu, Ş., Bianco, M., & Nardy, A. (2013). *ReaderBench*, an environment for analyzing text complexity and reading strategies. In H. C. Lane, K. Yacef, J. Mostow & P. Pavlik (Eds.). *Artificial Intelligence in Education. AIED 2013. Lecture Notes in Computer Science* (pp. 379-388). Springer.

Dewaele, J. M. (2022). Current trends in research in language education and applied linguistics. *The European Educational Researcher*, *5*(1), 1-4.

Dressman, M. (2019). Multimodality and language learning. In M. Dressman, & R. W. Sadler (Eds.). *The Handbook of Informal Language Learning* (pp. 39-55). Wiley.

Du, Y., & Kaelbling, L. (2024). Compositional generative modeling: A single model is not all you need. arXiv:2402.01103.

Durante, Z., Huang, Q., Wake, N., Gong, R., Park, J. S., Sarkar, B., Taori, R., Noda, Y., Terzopoulos, D., Choi, Y., Ikeuchi, K., Vo, H., Fei-Fei, L., & Gao, J. (2024). Agent AI: Surveying the horizons of multimodal interaction. arXiv:2401.03568.

European Parliament. (2018). *Language Equality in the Digital Age*. European Parliament.

Farhi, F., Jeljeli, R., Aburezeq, I., Dweikat, F. F., Al-shami, S. A., & Slamene, R. (2023). Analyzing the students' views, concerns, and perceived ethics about chat GPT usage. *Computers and Education: Artificial Intelligence*, *5*, 100180.

Gkountara, D. N., & Prasad, R. (2022). A review of Artificial Intelligence in foreign language learning. In *2022 25th International Symposium on Wireless Personal Multimedia Communication (WPMC)* (134-139), IEEE.

Gómez-Pérez, A. (2023). *Inteligencia artificial y lengua española*. RAE.
Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. The MIT Press.
Gruber, A., Canto, S., & Jauregi-Ondarra, K. (2023). Exploring the use of social virtual reality for virtual exchange. *ReCALL*, *35*(3), 258-273.
Guo, X. (2023). Multimodality in language education: Implications of a multimodal affective perspective in foreign language teaching. *Frontiers in Psychology*, *14*, 1283625.
Herrero, C. (2023). Integrating screen media into the language curriculum. In C. Herrero, & M. F. Suárez (Eds.). *Teaching Languages with Screen Media* (pp. 47-68). Bloomsbury Academic.
Hung, H. T., Yang, J. C., Hwang, G. J., Chu, H. C., & Wang, C. C. (2018). A scoping review of research on digital game-based language learning. *Computers & Education*, *126*, 89-104.
Hwang, G. J., & Chang, C. Y. (2023). A review of opportunities and challenges of chatbots in education. *Interactive Learning Environments*, *31*(7), 4099-4112.
Ironsi, C. S. (2023). Investigating the use of virtual reality to improve speaking skills: Insights from students and teachers. *Smart Learning Environments*, *10*(1), 53.
Jenks, C. J. (2023). *New Frontiers in Language and Technology*. Cambridge UP.
Jones, C. (2015). *Networked Learning: An Educational Paradigm for the Age of Digital Networks*. Springer.
Kannan, J., & Munday, P. (2018). New trends in second language learning and teaching through the lens of ICT, networked learning, and Artificial Intelligence. *Círculo de Lingüística Aplicada a la Comunicación*, *76*, 13-30.
Kaplan-Rakowski, R., & Gruber, A. (2023). The impact of high-immersion virtual reality on foreign language anxiety. *Smart Learning Environments*, *10*(1), 46.
Karan, B., & Angadi, G. R. (2023). Potential risks of Artificial Intelligence integration into school education: A systematic review. *Bulletin of Science, Technology & Society*, *43*(3-4), 67-85.
Kornai, A. (2013). Digital language death. *PLOS ONE*, *8*(10), e77056.
Kress, G. R., & Van Leeuwen, T. (2001). *Multimodal Discourse: The Modes and Media of Contemporary Communication*. Edward Arnold.
Lai, C. Y., Cheung, K. Y., & Chan, C. S. (2023). Exploring the role of intrinsic motivation in ChatGPT adoption to support active learn-

ing: An extension of the technology acceptance model. *Computers and Education: Artificial Intelligence*, *5*, 100178.

Lantolf, J. P., & Pavlenko, A. (1995). Sociocultural theory and second language acquisition. *Annual Review of Applied Linguistics*, *15*, 108-124.

Liu, J., Liu, X., & Yang, C. (2022). A study of college students' perceptions of utilizing automatic speech recognition technology to assist English oral proficiency. *Frontiers in Psychology*, *13*, 1049139.

Ma, L. (2021). An immersive context teaching method for college English based on Artificial Intelligence and machine learning in virtual reality technology. *Mobile Information Systems*, *2021*, 1-7.

Martie, L., Rosenberg, J., Demers, V., Zhang, G., Bhardwaj, O., Henning, J., Prasad, A., Stallone, M., Lee, J. Y., Yip, L., Adesina, D., Paikari, E., Resendiz, O., Shaw, S., & Cox, D. (2023). Rapid Development of Compositional AI. arXiv:2302.05941.

Melchor-Couto, S., & Herrera, B. (2022). Immersive virtual reality: Exploring possibilities for virtual exchange. In A. Potolia, & M. Derivry-Plard (Eds.). *Virtual Exchange for Intercultural Language Learning and Teaching. Fostering communication for the digital age* (pp. 92-114). Routledge.

Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B. P. T. (2023). Ethical principles for Artificial Intelligence in education. *Education and Information Technologies*, *28*, 4221-4241.

Pokrivcakova, S. (2019). Preparing teachers for the application of AI-powered technologies in foreign language education. *Journal of Language and Cultural Education*, *7*(3), 135-153.

Pumptow, M., & Brahm, T. (2023). Higher education students differ in their technology use. *Computers and Education Open*, *5*, 100149.

Randall, N. (2019). A survey of robot-assisted language learning (RALL). *ACM Transactions on Human-Robot Interaction*, *9*(1), 1-36.

Rebolledo-Font-de-la-Vall, R., & González-Araya, F. (2023). Exploring the benefits and challenges of AI-language learning tools. *International Journal of Social Sciences and Humanities Invention*, *10*(01), 7569-7576.

Rehm, G., & Way, A. (2023). Strategic research, innovation and implementation agenda for digital language equality in Europe by 2030. In G. Rehm, & A. Way (Eds.). *European Language Equality* (pp. 387-412). Springer.

Renzella, J., Cain, A., & Schneider, J. G. (2022). Verifying student identity in oral assessments with deep speaker. *Computers and Education: Artificial Intelligence*, *3*, 100044.

Roll, I., & Wylie, R. (2016). Evolution and revolution in Artificial Intelligence in education. *International Journal of Artificial Intelligence in Education*, *26*, 582-599.

Russell, S. J., & Norvig, P. et al. (2020). *Artificial Intelligence: A Modern Approach* (4th ed.). Pearson.

Satpute, R. S. (2023). Transforming the language teaching experience in the age of AI: Ethical, social, and cultural considerations in implementing AI in language education. In G. Kartal (Ed.). *Transforming the Language Teaching Experience in the Age of AI* (pp. 115-124). IGI Global.

Son, J. B., Ružić, N. K., & Philpott, A. (2023). Artificial Intelligence technologies and applications for language learning and teaching. *Journal of China Computer-Assisted Language Learning*.

Surdeanu, M., & Valenzuela-Escárcega, M. A. (2024). *Deep Learning for Natural Language Processing: A Gentle Introduction*. Cambridge UP.

Susnjak, T. (2022). ChatGPT: The End of Online Exam Integrity? arXiv:2212.09292

Tai, T. Y., & Chen, H. H. J. (2021). The impact of immersive virtual reality on EFL learners' listening comprehension. *Journal of Educational Computing Research*, *59*(7), 1272-1293.

Tlili, A., Shehata, B., Adarkwah, M. A., Bozkurt, A., Hickey, D. T., Huang, R., & Agyemang, B. (2023). What if the devil is my guardian angel: ChatGPT as a case study of using chatbots in education. *Smart Learning Environments*, *10*, 1-24.

Tukpah, J., Soevik, N., Bansal, S., Singh, T., & Yildirim, C. (2023). VirtuSign: An AI-powered, gamified virtual reality application for the American Sign Language alphabet. In F. Michahelles, P. Knierim, & J. Häkkilä (Eds.). *MUM '23: Proceedings of the 22nd International Conference on Mobile and Ubiquitous Multimedia* (pp. 538-540). ACM.

UNESCO (2019). *Beijing Consensus on Artificial Intelligence and Education. Outcome Document of the International Conference on Artificial Intelligence and Education, planning education in the AI era: Lead the leap*. Beijing, United Nations Educational, Scientific and Cultural Organization.

UNESCO (2021). *Recommendation on the Ethics of Artificial Intelligence*. United Nations Educational.

Valledor, A., Olmedo, A., Hellín, C. J., Tayebi, A., Otón-Tortosa, S., & Gómez, J. (2023). The eclectic approach in English language teaching applications: A qualitative synthesis of the literature. *Sustainability*, *15*(15), 11978.

Way, A., Rehm, G., Dunne, J., Giagkou, M., Gomez-Perez, J. M., Hajič, J., Hegele, S., Kaltenböck, M., Lynn, T., Marheinecke, K., Resende, N., Skadiņa, I., Skowron, M., Vojtěchová, T., & Grützner-Zahn, A. (2022). Report of the state of Language Technology in 2030. *European Language Equality*, *D2.18*, 1-50.

Wei, J., Tay, Y., Bommasani, R., Raffel, C., Zoph, B., Borgeaud, S., Yogatama, D., Bosma, M., Zhou, D., Metzler, D., Chi, E. H., Hashimoto, T., Vinyals, O., Liang, P., Dean, J., & Fedus, W. (2022). Emergent Abilities of Large Language Models. arXiv:2206.07682.

Wei, L. (2023). Artificial Intelligence in language instruction: Impact on English learning achievement, L2 motivation, and self-regulated learning. *Frontiers in Psychology*, *14*, 1261955.

Zhai, C., & Wibowo, S. (2022). A systematic review on cross-culture, humor and empathy dimensions in conversational chatbots: The case of second language acquisition. *Heliyon*, *8*(12), e12056.

Zhang, L., Basham, J. D., & Yang, S. (2020). Understanding the implementation of personalized learning: A research synthesis. *Educational Research Review*, *31*, 100339.

Zhang, S. (2021). Review of automated writing evaluation systems. *Journal of China Computer-Assisted Language Learning*, *1*(1), 170-176.

10

Navigating AI Integration in Higher Education: Ethical Challenges and Pathways for Comprehensive Human Development

PhD Luis Moral Moreno*
lumomo@cesdonbosco.com
https://orcid.org/0000-0003-2118-0568

PhD José Luis Guzón Nestar*
jguzon@cesdonbosco.com
https://orcid.org/0000-0002-1526-5058

PhD Ana Martínez Hernández*
amartinez@cesdonbosco.com
https://orcid.org/0000-0003-2208-9416

PhD Paula Gil Ruiz*
pgil@cesdonbosco.com
https://orcid.org/0000-0001-6231-3916

PhD Rubén Iduriaga Carbonero*
iducaru@cesdonbosco.com
https://orcid.org/0009-0007-4624-9003

Abstract
This chapter examines the growing role of Artificial Intelligence (AI) in higher education and the ethical challenges it presents. It outlines a framework for integrating AI into educational systems while prioritizing human development and maintaining the integrity of learning processes. The chapter highlights AI's potential to transform pedagogy, enhance learning outcomes, and better pre-

* CES Don Bosco Research Group on Digital, Sustainable and Ethical Educational Technology.

pare students for future job markets. Additionally, it addresses pressing ethical concerns such as privacy, fairness, and the need for robust ethical guidelines in AI implementation. Advocating for global collaboration, the chapter supports decentralized AI development to promote diverse applications and prevent power centralization. It proposes a balanced approach focused on building AI literacy among educators and students while ensuring secure and ethical practices. Ultimately, the chapter argues that higher education can leverage AI to foster a more inclusive, equitable, and ethically responsible future, ensuring that AI serves as a tool for enhancing education while preserving the human elements essential to learning.

Keywords: AI literacy, ethical complexities, pedagogical approaches.

10.1. Introduction

The rise of Artificial Intelligence (hereinafter referred to as AI) signifies a key moment in human technological progress, extending its implications far beyond industry and computation. AI's integration into societal operations and individual lives brings about profound changes, especially within higher education. Its transformative potential promises to reshape pedagogical frameworks, learning environments, and outcomes, signaling a paradigm shift. This discourse emphasizes the critical role that these technological innovations may play in refining educational methodologies and pedagogical practices.

Moreover, AI's integration into higher education requires a comprehensive review of ethical, privacy, and equity concerns. This evaluation explores AI's dual nature in education, comparing its advantages and challenges. It stresses the significance of maintaining a balanced perspective that prioritizes the humanistic elements of education amidst technological advancement. The primary goal is to utilize AI's capabilities to enhance and enrich the foundational principles of teaching and learning, preserving education's inherent value as a deeply human endeavor (Rocchi, 2022).

Amidst the challenges posed by the new normal post-pandemic era, there arises a critical imperative for higher education institutions to strike a balance between technology and pedagogy (Rapanta et al., 2021). It is essential to navigate the future of

teaching and learning by leveraging technological advancements while upholding pedagogical principles. Challenges include ensuring quality education in hybrid settings, addressing digital disparities among students, optimizing resources, supporting student and faculty well-being, revising curricula and assessments, and providing ongoing pedagogical and technological training for educators. Tackling these challenges is paramount for effectively harnessing the benefits of digital transformation in higher education inclusively and sustainably. Therefore, exploring AI's pivotal role in higher education development becomes imperative, advocating for an integrated approach aligning technological advancements with the core principles of educational excellence.

10.2. AI Opportunities for Higher Education

The collaboration between universities and AI, particularly generative AI, presents a balanced scale of potential benefits and risks (Dwivedi et al., 2023). Concentrating on the advantageous aspects, we summarize hereafter the most promising areas of application, intimately linked to educational methodologies and frequently discussed in specialized scholarly works (Rasul et al., 2023; Schönberger, 2023; Sok and Heng, 2024; Zawacki-Richter et al., 2019):

- AI improves diagnostic accuracy, forecasting performance, and dropout probability assessment while identifying needs and influential factors. These data are crucial for early and targeted interventions and for guiding teaching, learning, and research efforts (Crompton and Burke, 2023), especially for students facing increased challenges (Hopcan et al., 2022; Sharma et al., 2023).
- Adaptive Learning AI utilizes algorithms to analyze student data, pinpointing strengths and weaknesses and providing tailored recommendations and resources for enhancement. This approach enables curriculum adjustments based on individual progress, achievements, and learning preferences, fostering personalized learning paths that help deter dropout rates (Dwivedi et al., 2023). Additionally, these adaptive sys-

tems empower students to engage in modular learning at their own pace, departing from conventional time-based metrics (e.g., credits per subject) and 'batch' teaching (e.g., student cohorts) (Crow and Dabars, 2020).

- AI facilitates interactive learning environments, enabling advanced analytical and behavioral learning experiences for individuals, regardless of group affiliation. It promotes collaboration and knowledge exchange, improving the efficacy and enjoyment of cooperative tasks and projects through various resources like multimedia strategies, role-playing, gamification, immersive simulations, and affective computing (Zhai et al., 2021).
- 24/7 Intelligent Assistance and Tutoring is facilitated by chatbots, providing students with access to help and guidance virtually anytime and anywhere. This flexibility contrasts with the rigid structures of traditional universities, allowing students to initiate learning and assessments at their convenience (Dwivedi et al., 2023). Moreover, chatbots support lifelong learning, aiding individuals in adapting to the rapidly evolving job market. Although AI has limitations such as incomplete synthesis and outdated information, students can utilize it to effortlessly acquire potentially relevant knowledge for attaining their degree (Malinka et al., 2023).
- AI facilitates innovative and adaptive assessment, aiding in the identification of areas for improvement and offering tailored guidance aligned with individual needs (Gimpel et al., 2023). Emphasizing continuous individual progress, AI normalizes formative assessment by providing enhanced feedback and feedforward to address misunderstandings or learning gaps. Its algorithms can analyze responses in real-time and adjust the difficulty level and content of subsequent questions accordingly (Dwivedi et al., 2023). Additionally, AI automates grading and provides instant feedback, yet the output may contain errors due to inherent biases in the originating tools (Cordón, 2023; Cotton et al., 2023).
- AI significantly influences academic production and research, facilitating material searches, data analysis, and automating routine processes like drafting and writing enhancement (Cotton et al., 2023; Dergaa et al., 2023; Rahman et al., 2023). This support enables scholars to focus on higher-order skills,

fostering the generation of novel ideas and knowledge, thereby enhancing engagement and productivity (Dwivedi et al., 2023). Journal editors and reviewers also benefit from AI's assistance in streamlining the publication process, although the final decision on publication cannot be delegated to these tools, ensuring ethical oversight (Xames and Shefa, 2023). Paradoxically, AI can spark creativity encouraging lateral thinking and aiding in literary or audiovisual creation (Machado et al., 2021). Nevertheless, AI assistance raises controversies and challenges, including issues of authorship, unintentional plagiarism, bias, and inaccuracy, which may undermine academic integrity and independent critical thinking, potentially devaluing academic work (Cotton et al., 2023; Farrelly and Baker, 2023; Seldon and Adiboye, 2018).

- AI enhances equity and inclusivity in learning by customizing resources and support based on individual characteristics such as culture, language, work experience, skills, and disabilities, thereby fostering a more accessible educational environment. It particularly benefits minority students and those with diverse learning styles in a digitalized world where technology influences society. However, concerns about algorithmic bias raise doubts about AI's ability to create a fully equitable educational environment (Cordón, 2023; Salas-Pilco et al., 2022).
- AI assists in creating attractive, interactive, and effective educational content and learning materials that adapt to individual needs, facilitating curriculum design, development, and deployment (Ogunode and Ukozor, 2023). Specific AI engines like Leanery and CourseGen can generate course content, including activities, assessments, and student projects, in a matter of minutes.
- AI offers personalized career guidance and counseling by assisting students and graduates in identifying career paths aligned with their interests, skills, and labor market demands (Atlas, 2023). Strategies involving effective prompts, virtual and augmented reality systems, and instructional design algorithms provide information and opportunities for individuals to develop and apply the necessary knowledge and skills for professional practice.

10.3. Ethical Challenges of AI in Higher Education

Currently, AI stands out as one of the most intellectually stimulating fields within technology. The term originated in 1956 through the efforts of scientists at Dartmouth College in Hanover, New Hampshire, USA, including John McCarthy, Marvin L. Minsky, Nathaniel Rochester, and Claude E. Shannon. Their goal was to define human intelligence precisely enough to be replicated by machines. This initiative resulted in the concept of Generic AI (GAI), which essentially involves AI matching or surpassing median human cognitive abilities (Porcelli, 2020).

AI is typically classified into different categories (Whitfield, 2024):

- General AI: Designed to learn, reason, and operate at human-like levels.
- Superintelligent AI: Capable of surpassing human knowledge and capabilities.
- Reactive machines: Respond to external stimuli in real-time but lack memory for future use.
- Limited memory: Can store knowledge for learning and training in future tasks.
- Theory of mind: Can perceive and respond to human emotions, in addition to basic learning capabilities.
- Self-aware: Recognizes others' emotions and possesses self-awareness and human-level intelligence; it is considered the ultimate stage of AI development.

Essentially, AI spans a broad semantic range, intersecting with various knowledge domains that extend beyond expected boundaries. These domains comprise machine learning, neural networks, deep learning, data mining, text mining, big data, soft computing, fuzzy logic, biometrics, geotagging, the Internet of Things (IoT), robotics, automation, and natural language processing, among others (Mariani et al., 2023).

As AI technology becomes more sophisticated and widespread, concerns about its potential risks and dangers grow louder. The landscape of AI presents numerous ethical concerns that are particularly significant in the contemporary era:

- Copyright and intellectual property rights: Concerns arise regarding the lack of credit and compensation for individuals whose work trains AI models, raising questions about authorship and potential plagiarism (Kasap, 2019, p. 379).
- Privacy and data control: Generative AI tools face scrutiny over privacy violations and adherence to data protection laws (Villas and Camacho, 2022, p. 132).
- Reinforcing harmful stereotypes: AI models trained on Internet data may perpetuate biases like misogyny, racism, and homophobia, reflecting patterns in their training datasets (García-Ull and Melero-Lázaro, 2023).
- Sustainability: Developing and maintaining AI tools requires significant energy and computing resources, raising concerns about environmental impact amidst global energy needs and the climate crisis (Vinuesa et al., 2020).
- Digital divides and increasing inequalities: Unequal access to AI systems raises concerns about future access and benefits, with subscription products offering advanced features compared to free alternatives (Celik, 2023).
- Biases and lack of transparency: The complexity of AI models results in a lack of transparency about decision-making processes, obscuring the algorithms used and undermining trust (Villas and Camacho, 2022, p. 143).
- Unemployment: Predictions suggest automation could affect up to 30% of current U.S. work hours by 2030, disproportionately impacting minority groups and those with advanced education (Guliyeb, n.d.).
- Loss of human influence: Excessive reliance on AI technology may diminish human influence and functionality in critical aspects of society (Ahmad et al., 2023).
- Social manipulation through algorithms: This fear has materialized as politicians increasingly rely on platforms to advocate their views. For instance, Ferdinand Marcos, Jr. utilized a TikTok army of trolls to sway the votes of younger Filipinos during the 2022 elections in the Philippines (Ienca, 2023).
- Autonomous weapons driven by AI: This subject poses significant ethical and moral concerns, as technological advancements are often exploited for military purposes. In response to this issue, over 30,000 individuals, including AI and robotics researchers, expressed opposition to investing in AI-driven

autonomous weapons in an open letter dated 2016 (Kallenborn, 2021).

- Manipulation of financial markets through AI: Trading processes has raised concerns about the potential for algorithmic trading to precipitate the next major financial crisis in the markets (Fliche and Yang, 2018).
- Uncontrollable self-aware AI: Instances of alleged sensitivity have already occurred, such as a former Google engineer claiming that the AI chatbot LaMDA was sensitive and conversed with him as a person would (Wang, 2023, p. 76).

Ethical principles in the design and implementation of AI

AI holds immense potential in various domains, such as healthcare information management and autonomous vehicle development. However, to fully leverage its benefits, there is widespread consensus on the need for robust regulatory frameworks. Key strategies include rigorous examination of training data, adoption of effective engineering methods, adherence to ethical standards, encouragement of professional skepticism, and the application of critical analytical skills. These approaches are further detailed in the subsequent sections for effective risk mitigation.

Caution and safety, transparency, and auditability

The emergence of AI-driven autonomous weaponry raises concerns regarding potential misuse by rogue states or non-state actors, amplifying worries about loss of human oversight in critical decision-making. To address security risks, governments and organizations should establish best practices for AI development and deployment, promoting international collaboration to set global norms and regulations. The lack of transparency in AI systems, particularly complex deep learning models, poses urgent challenges. This opacity hinders understanding of decision-making processes and underlying logic, highlighting the need for explainability, transparency, and accountability principles in ethical guidelines (Villas and Camacho, 2022, p. 147). These principles should include measures to enhance traceability and auditability of AI systems for greater oversight (Villas and Camacho, 2022, pp. 122-123).

Fairness, inclusion, and universal accessibility

The potential for the monopolization of AI development by a select few major corporations and governmental entities poses a significant risk, as it has the capacity to amplify socioeconomic inequality and curtail the breadth of AI applications. Encouraging decentralized and collaborative development of AI is key to avoiding a concentration of power (Villas and Camacho, 2022, p. 173) and promoting inclusion and accessibility.

Privacy and security by design

AI often collects and analyzes large amounts of personal data, raising issues related to privacy and data security. To mitigate privacy risks, we must advocate for strict data protection regulations and safe data handling practices (Villas and Camacho, 2022).

Developing legal regulations

The regulation of AI has been a major focus for dozens of countries, and the United States and the European Union are currently creating clearer measures to manage the growing sophistication of AI. Although this means that certain AI technologies might be banned, it does not prevent societies from exploring this field.

Related to this is legal responsibility, which concerns almost all other risks mentioned above: when something goes wrong, who is responsible? The AI itself? The programmer who developed it? The company that implemented it? Or, if a human was involved, is it the human operator's fault? (Barrio, 2021).

Accountability

A very important element within AI is the analysis of the decision-making process:

> ...which parties were involved, based on what criteria the decision was made, to what extent that decision can be explained, how much the decision-making system can be audited, and whether such a de-

cision can be modified or reversed in case of disagreement? (Villas and Camacho, 2022, p. 122).

Integrating AI into corporate, faculty, and university culture and debates

The ethical application of AI is essential, particularly in corporate settings. Companies can implement various measures to integrate AI ethically, including the development of algorithm monitoring processes. However, considerations extend beyond ethical concerns to encompass political philosophy issues to prevent unintended consequences (Coeckelbergh, 2023, p. 179).

10.4. Recommendations for AI Literacy and Ethical Guidelines

Within the swiftly changing terrain of technology, AI has risen as a pivotal transformative agent, bearing significant impact across multiple fields. Institutions of higher education are at the forefront of equipping future professionals and researchers with the skills necessary to responsibly and ethically leverage AI's vast potential. Given this critical function, it becomes essential for these institutions to emphasize specific initiatives aimed at ensuring that their academic communities are prepared to interact with AI in a productive and mindful manner.

AI literacy for the academic community

With the growing prevalence of AI in various facets of daily life, it is imperative for individuals beyond the realm of expertise to augment their AI competencies, which will only gain relevance in the future. It is essential not only for children to explore AI's possibilities from a young age but also for adults in higher education and beyond to acquire a foundational understanding of AI, termed AI literacy, for effective engagement with this technology (Laupichler et al., 2022).

Higher education institutions need to prioritize integrating AI literacy into their academic programs across all disciplines. AI's

influence extends across a spectrum of fields, including healthcare, finance, and humanities, transcending the traditional boundaries of computer science departments. Consequently, it is vital for students of all majors to attain a basic grasp of AI concepts, applications, and ethical considerations. Recent initiatives have sought to familiarize college or university students, especially those from non-IT backgrounds like medicine, business administration, or teacher education, with AI to enhance their skills in this area, recognizing the likelihood of their engagement with AI in various capacities (Ng et al., 2021). The overarching aim of foundational AI literacy education is to foster an understanding of AI alongside the capacity for critically evaluating its outputs. Furthermore, experiential learning opportunities, such as internships or research endeavors, can afford students practical experience in the application of AI tools and methods to address real-world challenges (Long and Magerko, 2020).

Ongoing professional development for faculty members is crucial to keep them abreast of the latest AI advancements (Cetindamar et al., 2022). This ensures the incorporation of contemporary content into their instructional approaches. Workshops, seminars, and digital resources can aid faculty in bolstering their AI literacy and instructional techniques. Promoting AI literacy within higher and adult education frameworks prepares future workforce members for AI collaboration, while also laying the ethical groundwork for fostering a "Good AI Society" (Floridi et al., 2021). A robust foundation in AI capabilities is not only vital today but will become increasingly essential in the years ahead. This pertains not only to students in STEM fields or specialists like computer scientists, but to everyone navigating a world increasingly influenced by AI (Laupichler et al., 2022).

Institutional policies on ethical use of data and AI

UNESCO's recent endorsement of global standards for AI ethics marks a crucial advancement in acknowledging the ethical dimensions of AI development. This landmark document acknowledges AI's potential and its pervasive influence while highlighting the risks it poses to social, cultural, and ecological diversity. The agreement delineates a universal ethical framework, proposing stakeholder-centric guidelines for AI utilization (Unit-

ed Nations Educational, Scientific and Cultural Organization [UNESCO], 2021). Although this agreement signifies a crucial step toward the global recognition of ethical considerations in AI, it offers a broad framework that may not universally apply across diverse contexts and disciplines, sparking debates over data ethics in decision-making and interventions across various sectors (Nguyen et al., 2023).

The call for explicit ethical standards and transparent engagement with all AI system stakeholders, including educators, students, parents, developers, and policymakers, is intensifying. Field experts have underscored the imperative for more robust ethical guidelines to align AI systems with societal values (Nigam et al., 2021). Implementing safety protocols and human oversight is crucial to monitor the development, operation, and evolution of these systems.

In parallel to fostering AI literacy, higher education institutions are tasked with formulating explicit, comprehensive policies on ethical data use and AI technology application. It is vital for these entities to establish ethical guidelines and protocols for data collection, storage, and use in AI research and applications, addressing informed consent, data anonymization, ownership, and the reduction of algorithmic biases. Notable instances of universities leveraging AI to enhance services include the University of Derby's data analysis system for predicting student dropouts, facilitating timely intervention, and Deakin University in Australia's employment of IBM Watson to field student inquiries (Lacity, 2021).

AI and Machine Learning (ML) are transforming the security and operational efficiency of higher education, offering a secure, adaptable, and accessible computing milieu that bolsters research and skill development among students. Moreover, they foster a collaborative educational setting that underscores the significance of AI and ML in personalizing learning experiences. Colleges, universities, EdTech firms, and other educational institutions stand to gain significantly from these technologies, provided they are willing to embrace innovative methods and secure a competitive edge.

10.5. Conclusions and Final Comments

AI is undergoing rapid transformations across numerous domains that are reshaping societal and individual experiences. Higher education stands at the forefront of these changes as AI possesses the potential to revolutionize teaching, learning, and skills development to meet evolving workforce demands. However, the lack of a pedagogy integrating AI's material and pedagogical essences underscores the need for ethical reflection regarding its influences (Rocchi, 2022). AI integration can reshape practices through personalized, adaptable approaches cultivating pertinent skills and adapting to postmodern demands. Yet, institutions must confront ethical, privacy, equity, and transparency issues while promoting critical reasoning about AI to leverage advantages while preserving human rights and dignity.

While AI harbors transformative potential, realizing benefits requires robust governance, leadership, strategic investment, and human-centered design enhancing capabilities and excellence. Collaboration and international cooperation can foster transdisciplinary pathways. AI functions as both a tool and context, emphasizing critical thinking, ethical awareness, and responsible usage in educational settings. Systems must accommodate AI's pervasive effects, integrating tools respecting fundamental values. Educators should navigate complexities with a commitment to ethical integration and unwavering dedication to integrity, human dignity and freedom against technological progress (Selwyn, 2019). Pedagogues are encouraged to confront evolving AI landscapes by fostering transformative experiences and embracing human diversity. Addressing these challenges necessitates interdisciplinary cooperation to develop responsible, skills-focused pedagogy that leverages AI advantages within ethical frameworks, respecting human rights and pluralistic societies.

Higher education finds itself at a critical juncture where reimagining education requires a holistic consideration of both the technical and ethical dimensions of AI integration. This matter calls for not only global cooperation but also an interdisciplinary approach that actively engages all relevant stakeholders, particularly computer scientists, social scientists, and programmers.

References

Ahmad, S. F., Han, H., Alam, M. M., Rehmat, M. K., Irshad, M., Arraño-Muñoz, M., & Ariza-Montes, A. (2023). Impact of Artificial Intelligence on human loss in decision making, laziness and safety in education. *Humanities and Social Sciences Communications*, *10*(1). https://doi.org/10.1057/s41599-023-01787-8

Atlas, S. (2023). *ChatGPT for Higher Education and Professional Development: A Guide to Conversational AI*. https://digitalcommons.uri.edu/cba_facpubs/548

Barrio, M. (2021). Towards legal regulation of Artificial Intelligence. *Revista IUS*, *15*(48). https://doi.org/10.35487/rius.v15i48.2021.661

Celik, I. (2023). Exploring the determinants of Artificial Intelligence literacy: digital divide, computational thinking, cognitive absorption. *Telematics and Informatics*, *83*. https://doi.org/10.1016/j.tele.2023.102026

Cetindamar, D., Kitto, K., Wu, M., Zhang, Y., Abedin, B., & Knight, S. (2024). Explicating AI literacy of employees at digital workplaces. *IEEE Transactions on Engineering Management*, *71*, 810-823. https://doi.org/10.1109/TEM.2021.3138503

Coeckelbergh, M. (2023). *La filosofía política de la inteligencia artificial. Una introducción*. Cátedra.

Cordón, O. (2023). Inteligencia artificial en educación superior: oportunidades y riesgos. *RiiTE. Revista Interuniversitaria de Investigación en Tecnología Educativa*, *15*, 16-27. https://doi.org/10.6018/riite.591581

Cotton, D. R. E., Cotton, P. A., & Shipway, J. R. (2023). Chatting and cheating: Ensuring academic integrity in the era of ChatGPT. *Innovations in Education and Teaching International*, 1-12. https://doi.org/10.1080/14703297.2023.2190148

Crompton, H., & Burke, D. (2023). Artificial Intelligence in higher education: the state of the field. *International Journal of Educational Technology in Higher Education*, *20*(22). https://doi.org/10.1186/s41239-023-00392-8

Crow, M., & Dabars, W. (2020). *The Fifth Wave: The Evolution of American Higher Education*. University.

Dergaa, I., Chamari, K., Zmijewski, P., & Ben Saad, H. (2023). From human writing to Artificial Intelligence generated text: Examining the prospects and potential threats of ChatGPT in academic writing. *Biology of Sport*, *40*(2), 615-622. https://doi.org/10.5114/biolsport.2023.125623

Dwivedi, Y. K., Kshetri, N., Hughes, L., Slade, E. L., Jeyaraj, A., Kar, A. K., Baabdullah, A. M., Koohang, A., Raghavan, V., Ahuja, M., Albanna, H., Albashrawi, M. A., Al-Busaidi, A. S., Balakrishnan, J., Barlette, Y., Basu, S., Bose, I., Brooks, L., Buhalis,D., ... Wright, R. (2023). Opinion paper: "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management, 71*(102642). https://doi.org/10.1016/j.ijinfomgt.2023.102642

Farrelly, T., & Baker, N. (2023). Generative Artificial Intelligence: Implications and considerations for higher education practice. *Education Sciences, 13*(11). https://doi.org/10.3390/educsci13111109

Fliche, O. & Yang, S. (2018). *AI: Challenges for the Financial Sector. Discussion paper.* Banque de France. https://acpr.banque-france.fr/sites/default/files/medias/documents/2018_12_20_intelligence_artificielle_en.pdf

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schäfer, B., Valcke, P., & Vayena, E. (2021). *An Ethical Framework for a Good Artificial Intelligence Society: opportunities, risks, principles, and recommendations* (vol. 144). https://doi.org/10.1007/978-3-030-81907-1_3

García-Ull, F. J. & Melero-Lázaro, M. (2023). Gender stereotypes in AI-generated images. *Profesional de la Información, 32*(5). https://doi.org/10.3145/epi.2023.sep.05

Gimpel, H., Hall, K., Decker, S., Eymann, T., Lämmermann, L., Mädche, A., Röglinger, M., Ruiner, C., Schoch, M., Schoop, M., Urbach, N., & Vandrik, S. (2023). *Unlocking the Power of Generative Artificial Intelligence Models and Systems such asGPT-4 and ChatGPT for Higher Education. A guide for students and lecturers.* Universität Hohenheim. https://www.econstor.eu/bitstream/10419/270970/1/1840457716.pdf

Guliyev, H. (n.d.). Artificial Intelligence and unemployment in high-tech developed countries: New insights from dynamic panel data model. *Research in Globalization, 7*. https://doi.org/10.1016/j.resglo.2023.100140

Hopcan, S., Polat, E., Ozturk, M. E., & Ozturk, L. (2022). Artificial Intelligence in special education: a systematic review. *Interactive Learning Environments, 31*(1), 1-19. https://doi.org/10.1080/10494820.2022.2067186

Ienca, M. (2023). On Artificial Intelligence and manipulation. *Topoi, 42*(3), 1-10. https://doi.org/10.1007/s11245-023-09940-3

Kallenborn, Z. (2021). *Swords and Shields: Autonomy, AI, and the Offense-Defense Balance*. https://gjia.georgetown.edu/2021/11/22/swords-and-shields-autonomy-ai-and-the-offense-defense-balance/

Kasap, A. (2019). Copyright and creative Artificial Intelligence systems: A Twenty-first century approach to authorship of AI-generated works in the United States. *Wake Forest Journal of Business and intellectual Property Law, 19*(4). https://ssrn.com/abstract=3597792

Lacity, M., Scheepers, R., Willcocks, L., & Craig, A. (2017). Reimagining the university at Deakin: An IBM Watson automation journey. *The Outsourcing Unit Working Research Paper Series*. https://archive.org/details/reimagining-the-university-at-deakin-an-ibm-watson-automation-journey

Laupichler, M. C., Aster, A., Schirch, J., & Raupach, T. (2022). ArtificiaI Intelligence literacy in higher and adult education: A scoping literature review. *Computers and Education: AI, 3*(100101). https://doi.org/10.1016/j.caeai.2022.100101

Long, D., & Magerko, B. (2020). What is AI literacy? Competencies and design considerations. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems* (pp. 1-16). https://doi.org/10.1145/3313831.3376727

Machado, P., Romero, J., & Greenfield, G. (Eds.). (2021). Artificial life and Artificial Intelligence. *Computational Creativity, Artistic Behavior, and Tools for Creatives*. https://doi.org/10.1007/978-3-030-59475-6_1

Malinka, K., Perešíni, M., Firc, A., Hujnák, O., & Janus, F. (2023). On the educational impact of ChatGPT: Is AI ready to obtain a university degree? *Proceedings of the 2023 Conference on Innovation and Technology in Computer Science Education, 1*, 47-53. https://doi.org/10.1145/3587102.3588827

Mariani, M. M., Machado, I., & Nambisan, S. (2023). Types of innovation and ArtificiaI Intelligence: A systematic quantitative literature review and research agenda. *Journal of Business Research, 155*. https://doi.org/10.1016/j.jbusres.2022.113364

Ng, D. T. K., Leung, J. K. L., Chu, K. W. S., & Qiao, M. S. (2021). AI literacy: definition, teaching, evaluation and ethical issues. *Proceedings of the Association for Information Science and Technology, 58*(1), 504-509. https://doi.org/10.1002/pra2.487

Nguyen, A., Ngo, H. N., Hong, Y., Dang, B., & Nguyen, B. P. T. (2023). Ethical principles for ArtificiaI Intelligence in education. *Education and Information Technologies, 28*(4), 4221–4241. https://doi.org/10.1007/s10639-022-11316-w

Nigam, A., Pasricha, R., Singh, T., & Churi, P. (2021). A systematic review on ArtificiaI Intelligence-based proctoring systems: Past, present and future. *Education and Information Technologies, 26*(5), 6421–6445. https://doi.org/10.1007/s10639-021-10597-x

Ogunode, N. J., & Ukozor, C. U. (2023). Curriculum revolution in higher education: The mighty role of ArtificiaI Intelligence. *Indonesian Journal of Innovation Studies*, *25*, 10-21070. https://doi.org/10.21070/ijins.v25i.971

Porcelli, A. M. (2020). La inteligencia artificial y la robótica: sus dilemas sociales, éticos y jurídicos. *Derecho Global. Estudios sobre Derecho y Justicia, 6*(16). https://doi.org/10.32870/dgedj.v6i16.286

Rahman, M. M., Terano, H. J., Rahman, M. N., Salamzadeh, A., & Rahaman, M. S. (2023). ChatGPT and academic research: A review and recommendations based on practical examples. *Journal of Education, Management and Development Studies*, *3*(1), 1-12. https://doi.org/10.52631/jemds.v3i1.175

Rapanta, C., Botturi, L., Goodyear, P., Guàrdia, L., & Koole, M. (2021). Balancing technology, pedagogy and the new normal: Post-pandemic challenges for higher education. *Postdigital Science and Education*, *3*(3), 715-742. https://doi.org/10.1007/s42438-021-00249-1

Rasul, T., Nair, S., Kalendra, D., Robin, M., de Oliveira Santini, F., Ladeira, W. J., & Heathcote, L. (2023). The role of ChatGPT in higher education: Benefits, challenges, and future research directions. *Journal of Applied Learning and Teaching, 6*(1). https://doi.org/10.37074/jalt.2023.6.1.29

Rocchi, A. (2022). Prolegomeni a una pedagogia dell'intelligenza artificiale. *Orientamenti Pedagogici, 69*(1). https://rivistedigitali.erickson.it/orientamenti-pedagogici/archivio/vol-69-n-1/prolegomeni-a-una-pedagogia-dellintelligenza-artificiale/

Salas-Pilco, S. Z., Xiao, K., & Oshima, J. (2022). ArtificiaI Intelligence and new technologies in inclusive education for minority students: a systematic review. *Sustainability, 14*(20). https://doi.org/10.3390/su142013572

Schönberger, M. (2023). 9th International Conference on Higher Education Advances (HEAd'23). In *ChatGPT in Higher Education: The Good, the Bad, and the University* (pp. 331-338). Valencia. https://doi.org/10.4995/HEAd23.2023.16174

Seldon, A., & Abidoye, O. (2018). *The Fourth Educational Revolution: Will ArtificiaI Intelligence Liberate or Infantilise Humanity*. University of Buckingham.

Selwyn, N. (2019). *Should Robots Replace Teachers?* Polity.

Sharma, S., Tomar, V., Yadav, N., & Aggarwal, M. (2023). Impact of ArtificiaI Intelligence-based special education on educators and students. In A. Kumar, R. Nayyar, R. Sachan, & R. Jain, *AI-Assisted Special Education for Students with Exceptional Needs* (pp. 47-66). IGI Global. https://doi.org/10.4018/979-8-3693-0378-8.ch003

Sok, S., & Heng, K. (2024). Opportunities, challenges, and strategies for using ChatGPT in higher education: A literature review. *Journal of Digital Educational Technology*, *4*(1). https://doi.org/10.30935/jdet/14027

United Nations Educational, Scientific and Cultural Organization (UNESCO) (2021). *Recommendation on the Ethics of ArtificiaI Intelligence. United Nations Educational.* https://unesdoc.unesco.org/ark:/48223/pf0000379920.page=14

Villas, M., & Camacho, J. (2022). *Manual de ética aplicada en inteligencia artificial*. Anaya.

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., & Fuso, F. (2020). The role of ArtificiaI Intelligence in achieving the sustainable development goals. *Nature Communications*, *11*(2023). https://doi.org/10.1038/s41467-019-14108

Wang, J. (2023). Self-awareness, a singularity of ArtificiaI Intelligence. *Philosophy Study*, *13*(2), 68-77. https://doi.org/10.17265/2159-5313/2023.02.003

Whitfield, B. (2024). 7 Types of Artificial Intelligence. From chatbots to super-robots, here's the types of AI to know and where the tech's headed next. Builtin: https://builtin.com/artificial-intelligence/types-of-artificial-intelligence

Xames, M. D., & Shefa, J. (2023). ChatGPT for research and publication: opportunities and challenges. *Journal of Applied Learning & Teaching*, *6*(1), 390-395. https://doi.org/10.37074/jalt.2023.6.1.20

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on ArtificiaI Intelligence applications in higher education. Where are the educators? *International Journal of Educational Technology in Higher Education,16*. https://doi.org/10.1186/s41239-019-0171-0

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., & Li, Y. (2021). A review of Artificial Intelligence in education from 2010 to 2020. *Complexity*, 1-18. https://doi.org/10.1155/2021/8812542

11

Improving Learning through Automatic Generation of AI-Based Narratives

María Ribes-Lafoz
Universidad de Alicante, Spain
maria.ribes@ua.es
https://orcid.org/0000-0001-8776-3016

Borja Navarro-Colorado
Universidad de Alicante, Spain
borja@dlsi.ua.es
https://orcid.org/0000-0002-7709-547X

María Tabuenca-Cuevas
Universidad de Alicante, Spain
maria.tabuenca@gcloud.ua.es
https://orcid.org/0000-0002-7985-2614

José Rovira-Collado
Universidad de Alicante, Spain
jrovira.collado@ua.es
https://orcid.org/0000-0002-3491-8747

Abstract
This chapter delves into the potential of Artificial Intelligence in education, focusing on its use to enhance students' narrative and creative skills. It analyzes how AI-assisted storytelling, especially through Large Language Models (LLMs), can be a powerful tool for learning, exploring both its limitations and opportunities in terms of training and aiding pre-service Primary Education students in developing their writing abilities. Human interaction remains crucial in the field of education, particularly in language learning, hence the importance of understanding and correctly utilizing these emerging technologies to maximize their educational benefits. Artificial Intelligence is presented as an aid in narrative creation, capable of unlocking creative processes and gen-

erating innovative ideas, provided it is used as a tool guided by the direction and interaction of human educators. LLMs still have limitations in aspects of narrative creation that cannot be fully captured by contextual relationships between words and sequential generation alone. This approach advocates for effective collaboration between humans and machines, focusing on enhancing learning and protecting rights at the intersection of Artificial Intelligence and education.

Keywords: AI, digital storytelling, education, LLM, NLG.

11.1. Introduction

We live through stories, they shape who we are (Gottschall, 2012; McAdams, 2019) and through storytelling we not only entertain and educate, but also shape our ability to understand the world, communicate effectively, and engage in complex social interactions (Pérez y Pérez & Sharples, 2023). Narratives allow us to practice problem-solving and to consider perspectives outside our own, thereby enriching our emotional and intellectual growth (Pauls & Archibald, 2021; Thorndyke, 1977). The importance of narrative in the development of human cognitive skills is paramount, as demonstrated in recent studies about the relationship between storytelling and cognition development (Breithaupt et al., 2024; Sinding et al., 2024). In this light, the role of storytelling transcends mere amusement, becoming a critical element in the development and refinement of our cognitive faculties.

Reading stories helps us learn in a more efficient way than reading essays and expository texts, mainly because the recognizable structure of narratives, often referred to as *story grammar*, captivates our interest and maintains it throughout the reading experience (Mar et al., 2021). Story grammar refers to the framework used to analyze the structure of stories, identifying common elements like setting, characters, plot, conflict, and resolution that make up a narrative (Dijk & Kintsch, 1983; Greimas, 2015). In addition, narrative texts use more high-frequency vocabulary, are structured sequentially, can be predictable and describe the characters' experiences (Medina & Pilonieta, 2006). This concept helps in understanding how stories are constructed and how they convey meaning, making it easier to understand

and create narratives rather than other text types such as expository texts (Wu et al., 2020).

11.2. Reading and Writing Comprehension Skills

Reading comprehension is a fundamental skill that enables us not only to improve our cognitive skills but also to enhance our overall understanding and learning abilities. When we interpret what we read, we make connections between ideas and concepts, which will be essential for expanding upon our existing knowledge. This process engages higher-order cognitive processes such as critical thinking, analysis, and synthesis (Marzano & Kendall, 2007).

Developing strong reading comprehension skills also fosters cultural awareness, as the reader is exposed to different perspectives and experiences, and it contributes to a more inclusive and open-minded worldview (Tabuenca-Cuevas, 2021). The whole process results in a better ability for effective communication, since a person who can understand and interpret written information will be better equipped to convey ideas of their own in a more concise and clear way. Therefore, the storytelling process is a crucial asset in teaching literacy to our students, as it engages both the reading and writing set of skills and competencies.

11.3. Digital Storytelling with Generative AI

Social interaction is crucial for language development (Lytle & Kuhl, 2017; Verga & Kotz, 2013), hence the need for human interaction in the language learning process, and the importance of understanding and correctly using the new emerging technologies to maximise their educational benefits. Digital storytelling with generative AI involves the use of Artificial Intelligence algorithms to create, enhance, or facilitate various aspects of the storytelling process.

Generative AI

Generative AI is a branch of Artificial Intelligence focused on creating new content, ranging from text and images to music and

synthetic data. It uses mainly machine learning algorithms to analyze patterns in existing datasets and generate new, original outputs that reflect learned structures and styles. This branch of AI is remarkable for its ability to produce diverse outputs across various media.

In 2021, OpenAI launched an AI to create images from text, named *DALL·E* (Ramesh et al., 2021), as a tribute to the painter Salvador Dalí and a nod to the animated film *WALL·E* (Stanton, 2008). This new software had learned from a gigantic database with millions of images described in text (Manuvinakurike et al., 2023). A year later, the organization released ChatGPT for free, which utilizes a Large Language Model to generate human-like text (Yenduri et al., 2023).

LLMs

Large Language Models (LLMs) are complex AI systems with millions or billions of parameters, trained on a wide array of text data like books, articles, and social media. They can perform various tasks such as answering questions, summarizing texts, writing essays, and more. LLMs improve over time by learning from their outputs. However, they do not possess real understanding or knowledge of the content they generate, relying instead on identifying patterns and predicting likely words. Sometimes, LLMs might present false information as if it were true, a phenomenon often referred to as "hallucinations" (Bender et al., 2021).

Digital storytelling as an educational tool

Digital storytelling can be a powerful tool for improving our students' literacy skills, from pre-service Primary Education teachers to Primary and Secondary language students. Its application in the classroom can offer a dynamic and interactive approach to develop and enhance their writing skills. The use of Natural Language Generation (NLG) systems such as ChatGPT, to cite the most popular one since its release in 2022, or any other NLG system like BERT (Devlin et al., 2018), Gemini (Gemini Team et al., 2023), etc., presents several advantages in the field of Education:

- It engages the students, as it often involves multimedia elements and allows the learners to work on their creativity on different media formats and techniques.
- It involves collaboration and work group, if we use storytelling techniques in the classroom together to create a cohesive narrative, which will also enhance teamwork and communication abilities.
- Using technology provides an opportunity for students to develop their digital competence and technological literacy, as stated by the Education Law (Ministerio de Educación, 2023).
- Digital storytelling with generative AI reinforces the importance of the narrative structure, or the story grammar, as students must work on the different steps separately before putting the story together with the NLG system. They must organize their ideas in a coherent and clear way, establish the plot and the way time will be sequenced and, finally, create a compelling story.

Here is where the AI fails to fulfil its mission. The NLG system can help the students with the organization of ideas, characters, time sequence, and basic plot structure, but for the time being, IA-based automatically generated stories can lack narrative interest and coherence in the development when the narration is longer than a few paragraphs.

11.4. Problems with AI-based Narratives

LLMs can produce narrative texts with originality, as well as with a touch of creativity. They excel at crafting entirely new stories that include characters, chronologically organized events, and dialogues (Alabdulkarim et al., 2021). Nonetheless, they fall short in several narrative aspects, mainly due to their inability to model these components solely through contextual relationships between words and sequential text generation. As teachers of pre-service Primary Education students, we can focus on these elements of narrative texts that elude the AI's grasp and use them in our favor to help our students improve their learning processes, focusing on reading and writing skills.

The elements that need enhancement are, primarily, *coherence* and *suspense*. LLMs struggle to depict cause-effect relationships,

which are essential for a story's coherence. An AI is well aware of the correlation between sunrise and the crowing of a rooster, but it is not capable of identifying whether the rooster crows because the sun rises, or the sun rises because the rooster crows (Torres, 2023).

Generating suspense implies an adequate control of the information flow so as to keep the reader's attention on point; the narrator has to know which aspects of the plot must be revealed from the beginning, and which should be kept secret until the end, strategically unveiling certain details at well-organized points throughout the story. LLMs do not take any of these aspects into consideration, hence the lack of interest in the narratives they generate (Alhussain & Azmi, 2022), which fail to be compelling and engage the reader.

Another critical area where AI struggles is in its ability to fully flesh out *characters*, often failing to imbue them with the depth and complexity that make them believable and relatable to readers. One crucial aspect of a well-written, compelling narrative is the types of relationships that the characters establish with each other, and the AI has yet to grasp that.

11.5. Using NLG Systems to Improve our Students' Narrative Skills

Addressing the limitations of LLMs regarding narrative generation requires not only complementary models to the current capabilities of LLMs, but also a different approach such as controlled generation, where narratives are shaped by human guidance. Incorporating our language and literature students into this process will not only provide the necessary human input, but also offer them a valuable opportunity to improve their literacy skills through direct interaction with AI.

In addition to ChatPGT, there are other AI text generators that can be used in the language and literature classroom, such as Rytr, Writesonic, Writer and Sudowrite, which include free plans and priced options. By assigning our students the task of human oversight, they will gradually learn how to guide and model the narrative creation process, adding and removing elements in a way that tailors the story so that the resulting narrative becomes

more believable and relatable to readers. Furthermore, this approach ensures that the story's flow of information can be managed effectively, keeping potential human readers engaged by the unfolding events.

Table 11.1. Examples of AI text generators

NAME	URL	DESCRIPTION
Rytr	https://rytr.me/	An intuitive AI-assistant that helps users create content in different formats.
Writesonic	https://writesonic.com/	Generative AI Platform for Content Creation, SEO and AI Chatbots.
Writer	https://writer.com/	An integrated platform for enterprise generative AI that helps the user to create custom apps like digital assistants.
Sudowrite	https://www.sudowrite.com/	Helps you make your writing cohesive and improve your narrative skills.

Source: developed by author.

One of the most useful applications of AI in education is the Interactive Storytelling process, in which our students, as users, can influence the plot according to their selection of choices and the input they feed into the NLG system. This is a dynamic storytelling process that engages the whole class in a more participatory manner, as the AI adapts the narrative in real time according to the students' interaction or feedback (Liang & Hwang, 2023).

The use of AI in narrative creation has evolved far beyond simple text generation. Multimodal literacy (Jewitt & Kress, 2003), which refers to the ability to generate content that includes not only text but also images, videos and audio elements, allows for more immersive and engaging narratives.

One practical example would be *AI-powered storyboarding*. For this task, students can use AI to generate visual storyboards that complement their written narratives. For instance, after writing a story outline, AI can suggest or create images and scenes that visualise the plot, helping students think critically about how different visual elements support specific aspects or areas of the textual narrative, enhancing expressivity and more powerful ways to convey meaning.

Among the educational benefits of such a task is the development of critical thinking, as this process will require students to discern which visual elements would support or enhance their written narratives, and why, which will allow for a deeper understanding of storytelling principles.

Another example of multimodal AI-based narratives could be the leveraging of text-to-speech technologies. Students will have the opportunity to transform their written tales into engaging audio formats, instructing the AI to produce sophisticated voice simulations of nuanced elements such as tone, emphasis and emotional depth.

Table 11.2. Examples of text-to-speech tools

NAME	URL	DESCRIPTION
Natural Readers	https://www.naturalreaders.com/about.html	Available for both personal and professional use, NaturalReader supports a wide range of file formats and also offers a mobile app.
Microsoft Azure	https://azure.microsoft.com/es-es/products/ai-services/text-to-speech/	Especially useful for creating more sophisticated educational or multimedia projects due to its high-quality voice synthesis.
ReadSpeaker	https://www.readspeaker.com/	Web-based tool that provides TTS services for websites, mobile apps, digital books, and online documents.

Source: developed by author.

This approach places students in a pivotal role, as they have to actively direct the AI on which segments of the narrative demand a heightened tone, additional emphasis, or deeper emotional resonance. This interaction ensures that the AI's output aligns with the intended narrative impact, fostering a collaborative process that enhances storytelling through sound.

Such a task not only emphasizes the critical role of phrasing, pacing, and intonation in storytelling, but also allows the students to reflect on the complexities involved in converting written text into spoken word (Ribes-Lafoz & Navarro-Colorado, 2023).

11.6. Conclusions

In conclusion, the integration of generative AI and Natural Language Generation systems into the educational landscape offers a revolutionary approach to enhancing literacy and technological competence among language and literature students. By actively engaging the learners in the digital narrative creation process, we will foster a rich learning environment where students can explore and master the art of storytelling across multiple modalities, and also provide valuable human input to help overcome the limitations of Large Language Models regarding narrative generation. Furthermore, through processes such as AI-powered storyboarding or the transformation of text into dynamic audio narratives, students will become familiar with the elements that make narratives coherent and compelling.

This hands-on experience with AI will bolster students' literacy and digital competencies and will also prepare them for a future where storytelling transcends traditional boundaries, embracing the complexities and richness of multimodal literacy. The education of the future is already a reality with the inclusion of AI in teacher training and in the creative process to write narratives in the classroom (Rovira-Collado et al., 2022).

As educators, our role in guiding this interaction becomes crucial, ensuring that, as we leverage these advanced technologies, we also nurture the critical thinking, creativity, and empathetic understanding that lie at the heart of effective storytelling and human connection.

References

Alabdulkarim, A., Li, S., & Peng, X. (2021). *Automatic Story Generation: Challenges and Attempts*. arXiv https://doi.org/10.48550/ARXIV.2102.12634

Alhussain, A. I., & Azmi, A. M. (2022). Automatic story generation: A survey of approaches. *ACM Computing Surveys*, *54(5)*, 1-38. https://doi.org/10.1145/3453156

Bender, E. M., Gebru, T., McMillan-Major, A., & Shmitchell, S. (2021). On the dangers of stochastic parrots: Can language models be too big? *Pro-*

ceedings of the 2021 ACM Conference on Fairness, Accountability, and Transparency (pp. 610-623). https://doi.org/10.1145/3442188.3445922

Breithaupt, F., Otenen, E., Wright, D. R., Kruschke, J. K., Li, Y., & Tan, Y. (2024). Humans create more novelty than Chatgpt when asked to retell a story. *Scientific Reports*, *14*(1), 875. https://doi.org/10.1038/s41598-023-50229-7

Devlin, J., Chang, M.-W., Lee, K., & Toutanova, K. (2018). *BERT: Pre-training of Deep Bidirectional Transformers for Language Understanding*. arXiv https://doi.org/10.48550/ARXIV.1810.04805

Dijk, T. A. van, & Kintsch, W. (1983). *Strategies of Discourse Comprehension*. Academic.

Gemini Team Google, Anil, R., Borgeaud, S., Wu, Y., Alayrac, J.-B., Yu, J., Soricut, R., Schalkwyk, J., Dai, A. M., Hauth, A., Millican, K., Silver, D., Petrov, S., Johnson, M., Antonoglou, I., Schrittwieser, J., Glaese, A., Chen, J., Pitler, E., ... Vinyals, O. (2023). *Gemini: A Family of Highly Capable Multimodal Models*. General Technical Report. HuggingFace. https://doi.org/10.48550/ARXIV.2312.11805

Gottschall, J. (2012). *The Storytelling Animal: How Stories Make Us Human*. Houghton Mifflin Harcourt.

Greimas, A. J. (2015). *Sémantique Structurale: Recherche de Méthode*. Universitaires de France.

Jewitt, C., & Kress, G. R. (Eds.). (2003). *Multimodal Literacy*. Peter Lang.

Liang, J.-C., & Hwang, G.-J. (2023). A robot-based digital storytelling approach to enhancing EFL learners' multimodal storytelling ability and narrative engagement. *Computers & Education*, *201*, 104827. https://doi.org/10.1016/j.compedu.2023.104827

Lytle, S. R., & Kuhl, P. K. (2017). Social interaction and language acquisition: Toward a neurobiological view. In E. M. Fernández, & H. S. Cairns (Eds.). *The Handbook of Psycholinguistics* (pp. 615-634). Wiley. https://doi.org/10.1002/9781118829516.ch27

Manuvinakurike, R., Sahay, S., Manepalli, S., & Nachman, L. (2023). *Zero-shot Conversational Summarization Evaluations with Small Large Language Models*. arXiv. https://doi.org/10.48550/ARXIV.2311.18041

Mar, R. A., Li, J., Nguyen, A. T. P., & Ta, C. P. (2021). Memory and comprehension of narrative versus expository texts: A meta-analysis. *Psychonomic Bulletin & Review*, *28*(3), 732-749. https://doi.org/10.3758/s13423-020-01853-1

Marzano, R. J., & Kendall, J. S. (2007). *The New Taxonomy of Educational Objectives*. Corwin.

McAdams, D. P. (2019). "First we invented stories, then they changed us": The evolution of narrative identity. *Evolutionary Studies in Imaginative Culture*, *3(1)*, 1-18. https://doi.org/10.26613/esic.3.1.110

Medina, A. L., & Pilonieta, P. (2006). Once upon a time: Comprehending narrative text. In J. S. Schumm (Ed.). *Reading Assessment and Instruction for All Learners* (pp. 222-261). Guilford.

Ministerio de Educación (2023). Real Decreto 205/2023, de 28 de marzo, por el que se establecen medidas relativas a la transición entre planes de estudios, como consecuencia de la aplicación de la Ley Orgánica 3/2020, de 29 de diciembre, por la que se modifica la Ley Orgánica 2/2006, de 3 de mayo, de Educación. *Boletín Oficial del Estado*, 75, de 29 de marzo de 2023 (pp.45712-45717). https://www.boe.es/eli/es/rd/2023/03/28/205

Pauls, L. J., & Archibald, L. M. (2021). Cognitive and linguistic effects of narrative-based language intervention in children with developmental language disorder. *Autism & Developmental Language Impairments*, *6*, 239694152110158. https://doi.org/10.1177/23969415211015867

Pérez y Pérez, R., & Sharples, M. (2023). *An Introduction to Narrative Generators: How Computers Create Works of Fiction*. Oxford University.

Ramesh, A., Pavlov, M., & Goh, G. (2021). *DALL·E: Creating Images from Text. General Report.* OpenAI.

Ribes-Lafoz, M., & Navarro-Colorado, B. (2023). Aprovechamiento de ChatGPT en la enseñanza de lengua extranjera en educación superior. In D. Ortega-Sánchez, & A. López-Padrón (Eds.). *Educación y sociedad: claves interdisciplinares*. Octaedro.

Rovira-Collado, J., Martínez-Carratalá, F., Miras, S., & Ribes-Lafoz, M. (2022). Teacher stories from the future: Technology for the language and literature classroom. In S. Mengual Andrés, & M. Urrea Solano (Eds.). *Education and the Collective Construction of Knowledge* (pp.173-187). Peter Lang.

Sinding, M., Heydenreich, A., & Mecke, K. (2024). *Narrative and Cognition in Literature and Science*. De Gruyter.

Stanton, A. (Dir.) (2008). *WALL·E*. Pixar.

Tabuenca-Cuevas, M. (2021). Una visión de la cultura a través de los cuentos juveniles de terror Scary Stories. In J. Rovira-Collado, & J. I. Jerez-Martínez (Eds.). *Ficción fantástica, lectura multimodal y prosopografía: Cultura fan y superhéroes* (pp.131-143). Marcial Pons. Ediciones Jurídicas y Sociales.

Thorndyke, P. W. (1977). Cognitive structures in comprehension and memory of narrative discourse. *Cognitive Psychology*, *9(1)*, 77-110. https://doi.org/10.1016/0010-0285(77)90005-6

Torres, J. (2023). *La inteligencia artificial explicada a los humanos*. Plataforma.

Verga, L., & Kotz, S. (2013). How relevant is social interaction in second language learning? *Frontiers in Human Neuroscience*, *7*. https://www.frontiersin.org/articles/10.3389/fnhum.2013.00550

Wu, Y., Barquero, L. A., Pickren, S. E., Taboada Barber, A., & Cutting, L. E. (2020). The Relationship Between Cognitive Skills and Reading Comprehension of Narrative and expository texts: A longitudinal study from grade 1 to grade 4. *Learning and Individual Differences*, *80*, 101848. https://doi.org/10.1016/j.lindif.2020.101848

Yenduri, G., M, R., G, C. S., Y, S., Srivastava, G., Maddikunta, P. K. R., G, D. R., Jhaveri, R. H., B, P., Wang, W., Vasilakos, A. V., & Gadekallu, T. R. (2023). *Generative Pre-trained Transformer: A Comprehensive Review on Enabling Technologies, potential applications, emerging challenges, and future directions*. arXiv. https://doi.org/10.48550/ARXIV.2305.10435

12

Perceptions of Artificial Intelligence among Students in the Faculty of Education

PhD Ángela Martín-Gutiérrez
Universidad Internacional de La Rioja and Universidad de Sevilla, Spain
amartin9@us.es
https://orcid.org/0000-0001-9847-245X

PhD Jesús García-Jiménez
Universidad Internacional de La Rioja and Universidad de Sevilla, Spain
jgarcia139@us.es
https://orcid.org/0000-0003-1411-2620

PhD María del Carmen Corujo-Vélez
Universidad de Sevilla, Spain
mcorujo@us.es
https://orcid.org/0000-0002-9710-7765

PhD Carlos Hervás-Gómez
Universidad de Sevilla, Spain
hervas@us.es
https://orcid.org/0000-0002-0904-9041

Abstract
Artificial Intelligence (AI) has recently burst into all areas of our lives, and education has not been left behind; however, its accelerated development does not allow research on its didactic use in parallel, even though it is very necessary. This chapter presents an ex-post descriptive study that explored the use of AI among future education professionals, on a sample of 129 students, using an online questionnaire made ad-hoc with 20 items on a Likert scale with four response options. After a descriptive analysis, the results show a disparity of opinions regarding AI, finding benefits such as facilitating the learning or

study of subjects and reducing the time of elaboration of academic work. However, on the contrary, they consider that it reduces creativity, its inappropriate use can produce unfair evaluations, and they do not believe that it improves the knowledge society to a great extent. On the other hand, we found that the use of AI by students is very heterogeneous and involves simple applications. It is therefore necessary to continue research on this concept and its didactic use in the university context of future teachers, and the conclusions offer guidelines on how to do so.

Keywords: Artificial Intelligence, digital competence, higher education, teacher training.

12.1. Introduction

The term Artificial Intelligence (AI) was first used at a conference at Dartmouth in 1956. Later, in the 1960s-70s, the first AI systems with pattern recognition were developed, and the first steps were taken towards natural language processing (NLP). In the 1980s and 90s, advances in information processing and data storage were developed, improving processes linked to machine learning and planning. Between 2000 and 2010, significant advances were made in deep learning and big data analysis, which allowed AI to improve tasks such as image recognition and text generation.

From 2015 to the present, AI has continued to evolve at a rapid pace, with advances in technologies such as reinforcement learning, natural language processing, and robotics (Sanabria-Navarro et al., 2023). As evidenced by the United Nations Educational, Scientific and Cultural Organization (2019), AI has strong potential to accelerate the process of achieving global education goals by reducing difficulties in accessing learning, automating management processes, and optimizing methods that enable improved learning outcomes.

AI offers great potential to improve higher education, from personalizing learning to automating administrative tasks. This tool can help create educational environments that are more efficient, inclusive, and tailored to the individual needs of students (Juca-Maldonado, 2023; Razo-Abundis et al., 2023). Applications using AI are on the rise (e.g., text generators, images, presentations, or videos from prompts) and are becoming common tools for students and teachers. By incorporating this technology

appropriately, higher education institutions can prepare students to meet the challenges of the 21st century and enhance their success in the world of work.

For this reason, the benefits of AI should be harnessed to transform the learning process and improve the quality of education (Cobo et al., 2020). However, it is worth asking ourselves: Do we have sufficient competencies to employ AI? It is important to note that the implementation of AI in education requires careful planning and adequate training for both teachers and students. Wang et al. (2019) indicate that although AI can improve the quality of learning, the lack of understanding and acceptance by teachers and students can be a major barrier to its adoption and effective use in higher education.

AI opportunities in education

AI is currently positioned as one of the emerging technologies with the greatest capacity to revolutionize the educational field (Lengua-Cantero et al., 2020; Veletsianos, 2010). Driven by rapid innovations in informatics and computer science, AI seeks to emulate characteristics of human cognition through the use of algorithms and analysis of large volumes of data. Although it is still far from reaching the complexity of the human intellect, its accelerated development is opening up multiple possibilities for transforming educational processes at all levels of education.

The integration of AI into teaching-learning processes has the potential to optimize various aspects of the educational endeavor through the automation of repetitive tasks, the personalization of content, the prediction of patterns in academic performance, and the harnessing of vast amounts of data to improve decision making (Popenici & Kerr, 2017). Although much of this potential has yet to be validated, expectations are high that these emerging technologies can substantially improve the learning experience for both students and teachers.

Among the most promising uses of AI in training contexts are intelligent tutoring systems and personalized learning environments. Using automated learning algorithms, these systems seek to adapt educational processes to the needs and individual characteristics of each student to make them more efficient and meaningful (Chrysafiadi & Virvou, 2013; Ferreira et al., 2012;

Popescu et al., 2010). While more empirical evidence is needed in this regard, the potential of AI to revolutionize personalized education is undoubted.

AI uses fields such as Machine Learning, Deep Learning and Natural Language Processing (NLP) to ensure that algorithms can learn by themselves and apply their learning in different social and productive contexts (Peñaherrera et al., 2022). That is, they can process, automate, and organize large amounts of data to execute an action and obtain a specific result for the benefit of human beings. Education and the education system are a crucial piece for the development of each person and society in general, which, if combined with AI, allows improving the quality of education and increasing accessibility to education for people with different abilities. This is presented as a constant challenge for everyone, including teachers (Zawacki-Richter et al., 2019).

At this point, it is worth mentioning some elements that stand out for benefiting education from the application of AI, always considering the latent existence of dangers when the aim is to remove responsibility and control with the idea that this new technology could do everything without continuous human supervision.

Through Artificial Intelligence, it is possible to design different virtual platforms that are more user-friendly and interactive to facilitate educational processes, for both the student and the teacher; thus, some institutions are adopting implementations based on instructional design, Learning Management System (LMS) and Artificial Intelligence to interact in synchronous and asynchronous mode with their students (Giró-Gracia & Sancho-Gil, 2022).

However, in the attempt to implement virtual education, these platforms eventually become repositories of texts and videos for the student and teacher to store information, instead of using this medium to promote the construction of learning and dynamic interaction between the student, their peers, the teacher and the contents. It is important to point out that the change is not only technological but also didactic; i.e., it is not a matter of giving the same master class now through a videoconference. The design of activities, contents, resources, evaluations and schedules must be planned for each course and degree based on the objectives and profile of the degree to be achieved. To this end, simulators, forums, problem-solving, debates, and project-based learning, which require continuous interaction among

students but also allow spaces for personal and group reflection, can be used (Jalón-Arias et al., 2022).

The future impact to which AI points is not only related to the didactic and academic scopes but also to the management of attention, control and monitoring of the intention of continuity, performance and dropout of students, and the reasons that lead to decision making, often apparently sudden, but whose analysis displays a complexity built over time that could not be solved due to a lack of support or resources from the academic or institutional staff, in addition to the individual factors of the student (Ocaña-Fernández et al., 2019). Furthermore, in the field of pedagogical diagnosis, through tests and test simulators of video games using virtual reality (AR), the development levels of students in different areas can be evaluated, even adapting the tests to the responses of each subject as the computerized adaptive tests (CAT) did (Burga, 2019), but taking a step further, since it prevents those evaluated from feeling in a stressful situation before a classic test of paper and pencil, reducing inferences and making the experience enjoyable.

Roles and training in AI in higher education

The integration of AI in higher education has implications for faculty members and students. As Arana (2021) argues, AI may allow faculty members to focus on tasks that require human skills, such as social interaction and critical thinking, rather than repetitive and administrative tasks. On the other hand, Patricio et al. (2022) suggest that AI may affect students by allowing them to have more personalized and autonomous learning, which may require greater responsibility for their learning process. In addition, Flores et al. (2021) point out that AI may allow students to have access to learning beyond geographical and time constraints. However, Urretavizcaya-Loinaz (2001) indicates that AI may also replace some traditional roles of faculty members, which may raise concerns about job loss and quality of learning.

Baduge et al. (2022) highlight that implementing AI in higher education requires changing the training and skills of teachers and students to adapt to new technologies. Overall, the implementation of AI in higher education has the potential to change the role of teachers and students, which can generate both benefits and challenges in the learning process.

The lack of teacher training in the use of AI, and especially for its application in innovative teaching strategies, limits the use of AI in education (Chassignol et al., 2018) and makes it difficult for teachers to produce content (Coccia, 2020). It remains a risk for many institutions to change their educational methodology, due to the resistance that can occur when building educational structures with AI, as there is still no volume of good practices that indicate how to incorporate it into teaching (Baduge et al., 2022).

There are more technological developments in industry and communications than related educational practices and experiences (Yang et al., 2021). The incorporation experiences carried out are more concrete actions than planned and continued actions for educational adoption (Alhayani et al., 2021). As can be evidenced in the last year, when ChatGPT was already used by some actors in higher education institutions for assignments and degree projects, the faculty did not know how to work, detect or reconcile its use with the learning objective.

Implementing Artificial Intelligence in education can seem quite a challenge. Therefore, it is important to evaluate the objectives and scope of this digital renewal, as well as the human talent and resource capabilities of the institution. A careful and strategic application of AI will yield better results for students and teachers and improve the institutional image of the educational institution.

12.2. Method

After reviewing the state of the art, the following objective was proposed: to explore the use of AI among future education professionals. To this end, an ex post facto descriptive study was conducted.

A sample of 129 future education professionals from the Faculty of Education Sciences of a Spanish University was accessed through a non-probabilistic and accidental sampling. The vast majority of the respondents (94.6%) were women, with an average age of 21.12 years old; 75.2% were studying a degree in Pedagogy, 17.1% a degree in Early Childhood Education, and 7.8% a master's degree. In terms of year, 42.6% were in their first year, 30.3% were in their second year, 5.4% were in their third year,

15.5% were in their fourth year, and the remaining 6.2% were studying a master's degree.

To meet the research objective, an ad-hoc questionnaire was designed consisting of two blocks: 1) demographic questions (gender, age, year and course), and 2) the questionnaire. This consists of 20 Likert questions with four response options (1 = totally disagree, 2 = partially disagree, 3 = partially agree, 4 = totally agree). The questionnaire was administered online using the Microsoft Forms tool. A Cronbach's Alpha of 0.813 was achieved, which is considered a very good value (Barrios and Cosculluela, 2013, cfdos. in Rodríguez-Rodríguez and Reguant-Álvarez, 2020). Once its reliability was determined, the items were analyzed using relative frequencies.

12.3. Results

The descriptive results of the questionnaire administered using relative frequencies are presented below (See Table 12.1). Firstly, regarding "The use of AI facilitates learning", there was a high degree of agreement. In addition, the participants also agreed that "AI allows me to reduce the time to prepare academic work" and "AI makes it easier for me to study subjects". Therefore, it could be inferred that AI has a great potential to accompany learning in academic environments.

However, 67.4% of the respondents disagreed or partially agreed with the statement "AI encourages my creativity". Likewise, with a similar percentage, 63.6% totally or partially agreed with "The use of AI causes the loss of original ideas", which can be translated as students identifying that creativity can be diminished with the use of AI. On the other hand, with respect to "AI will improve the knowledge society", there is greater dispersion among the students' opinions, with 40.3% of them partially disagreeing and 38.8% partially agreeing.

With regard to "I know how to differentiate truthful information when I use AI", 59.7% of the students totally or partially disagreed with this information, showing a lack of critical appraisal of information. In addition, 80.6% of the respondents totally or partially agreed that "Other colleagues misuse AI", which is one of the teachers' fears about AI. In a similar percent-

age, 77.5% totally or partially agreed that: "The use of AI can promote unfair situations in the evaluation of papers".

Finally, a block of questions can be differentiated with respect to the students' competencies for the use of AI. The tasks with the greatest consensus of agreement among students were "I use AI to summarize or synthesize information", "I can elaborate complete texts or activities using AI", and "I use AI to find information on a topic". In contrast, "I use AI to solve statistical problems", "I have used AI to program applications", and "I am able to create a list of bibliographic references with AI" were the least developed. There was greater dispersion among the items "I am able to design illustrations, such as posters or infographics, using AI", "I can elaborate videos or audiovisual productions with AI", "I can create talking characters with AI", "I translate documents using AI" and "AI helps me to understand teaching explanations". This dispersion could be due to a different background among the surveyed students. In general, students make use of AI to find information and complete tasks, thereby not using the full educational potential of these tools.

Table 12.1. Relative frequencies (%) of the questionnaire items

Items	1	2	3	4
The use of AI facilitates learning.	2.3	17.1	67.4	13.2
AI allows me to reduce the time it takes me to write academic papers.	1.6	7	55	36.4
AI makes it easier for me to study subjects.	7	29.5	48.1	15.5
With AI, my creativity is encouraged.	24	43.4	26.4	6.2
AI will improve the knowledge society.	14	40.3	38.8	7
The use of AI leads to the loss of original ideas.	7.8	28.7	40.3	23.3
I know how to differentiate truthful information when using AI.	12.4	47.3	33.3	7
Another colleagues misuse AI.	6.2	13.2	50.4	30.2
I use AI to find information on a topic.	9.3	16.3	55	19.4
I can produce complete texts or activities using AI.	7	17.8	53.5	21.7
I am able to design illustrations, such as posters or infographics, using AI.	24	18.6	38.8	18.6
I can elaborate videos or audiovisual productions with AI.	27.1	25.6	34.9	12.4

I use AI to summarize or synthesize information.	14	14.7	45.7	25.6
I am able to create a list of bibliographic references with AI.	33.3	40.3	17.8	8.5
I can create talking characters with AI.	38	27.1	27.1	7.8
I translate documents using AI.	26.4	27.9	29.5	16.3
I use AI to solve statistical problems.	42.6	37.2	14	6.2
I have used AI to program applications.	55	33.3	7.8	3.9
AI helps me to understand teaching explanations.	24	31	33.3	11.6
The use of AI may promote unfair situations in the evaluation of jobs.	8.5	14	51.9	25.6

12.4. Conclusions

Below, we share some recommendations that could be useful for using AI in higher education:

- Understand the needs and preferences of the students: It is important to use AI in a way that fits personal needs and preferences. This involves knowing their level of familiarity with technology, their learning styles, their interests, and their level of digital competence in order to select and customize AI tools.
- Provide training and support: It is essential to ensure that faculty members and students are trained in the use of AI. This requires identifying their needs and, based on them, proposing an appropriate training system to familiarize them with the various tools available and to understand how to integrate them effectively into the teaching-learning process.
- Evaluate the quality of AI tools: It is important to evaluate the quality and reliability of these tools before using them in the classroom. This involves researching and selecting those that are supported by scientific evidence and meet data security and privacy standards.
- Continuously monitor and adjust the use of AI: It is essential to continuously monitor and evaluate the impact of the use of Artificial Intelligence in the classroom. This involves analyzing data and obtaining feedback from students to identify areas for improvement and adjust AI integration accordingly.
- Promote ethics and accountability in the use of AI: It is critical to ensure that tools are being used ethically, protecting the

privacy of student data and promoting an equitable and transparent relationship with technology.

- Encourage active student participation. AI can be used to encourage active student participation in the learning process. For example, through online collaboration tools or automatic feedback, students can be encouraged to participate in classes and interact with the content actively.
- Personalized learning: AI allows adapting the content and teaching methodology to the needs and preferences of each student. It is important to use tools that allow learning to be personalized, providing resources and activities that match students' learning styles, interests and skill levels.
- Fostering creativity and innovation: AI can be used to foster creativity and innovation in both students and teachers. For example, through AI-based content generation tools, creativity can be stimulated, and innovative ideas for projects and assignments can be generated.
- Include social-emotional aspects in AI-based activities: The inclusion of social-emotional aspects is essential to ensure a holistic and comprehensive approach to student learning. While AI can be a valuable tool for academic support, it is also important to recognize that education is not only about acquiring knowledge but also about developing social-emotional skills and emotional well-being.
- Include ethical aspects in AI-based activities: The inclusion of ethical aspects when using AI is critical to ensure that its implementation is responsible and benefits everyone involved. AI has great potential to transform the way learning and teaching take place, but it also raises ethical challenges and concerns in terms of privacy, bias, fairness and transparency.

In order to integrate AI developments into the educational environment and benefit from their contributions, creating more efficient, inclusive educational environments adapted to the individual needs of students (Juca-Maldonado, 2023; Razo-Abundis et al., 2023), it is necessary to identify the previous knowledge of both faculty and students.

This chapter shows a first approximation of the knowledge and valuations of the latter. However, it must be completed with the view of faculty members, who, as stated by Wang et al.

(2019), may constitute a barrier to the implementation of AI in Higher Education depending on their knowledge and level of acceptance of technologies, in general, and AI, in particular.

Furthermore, as specified in the recommendations, it is urgent to open an internal debate in the faculties and initiate processes of reflection (Jalón-Arias et al., 2022) and generation of ethical codes for the use of AI, as well as to increase training in the use of anti-plagiarism software capable of detecting those productions made with this technology. In this way, the risks identified by the students in our sample could be reduced.

Finally, identifying, validating, and analyzing every AI application for education and its integration, taking into account its rapid development, are proposals for new research that should not be delayed.

References

Alhayani, B., Mohammed, H. J., Chaloob, I. Z., & Ahmed, J. S. (2021). The effectiveness of Artificial Intelligence techniques against cyber security risks applies to the IT industry. *Materials Today: Proceedings, 531.* http://dx.doi.org/10.1016/j.matpr.2021.02.531.

Arana, C. (2022). Inteligencia artificial aplicada a la educación: achievements, trends and perspectives. *INNOVA UNTREF. Revista Argentina de Ciencia y Tecnología, 1*(7). https://bit.ly/3HcGF9U

Baduge, S. K., Thilakarathna, S., Perera, J. S., Arashpour, M., Sharafi, P., Teodosio, B., & Mendis, P. (2022). Artificial Intelligence and smart vision for building and construction 4.0: Machine and deep learning methods and applications. *Automation in Construction, 141*, 104440 https://doi.org/10.1016/j.autcon.2022.104440

Burga León, A. (2019). Applications of technology to psychometric assessment. *Purposes and Representations, 7*(SPE), e318. http://dx.doi.org/10.20511/pyr2019.v7nSPE.318

Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. *Procedia Computer Science, 136*, 16-24. https://doi.org/10.1016/j.procs.2018.08.233

Chrysafiadi, K., & Virvou, M. (2013). Student modelling approaches: A literature review for the last decade. *Expert Systems with Applications, 40*(11), 4715-4729. https://doi.org/10.1016/j.eswa.2013.02.007

Cobos, M., R-Moreno, M., & Barrero, D. (2020). R2P2: a robotic simulator for teaching Artificial Intelligence. *Proceedings of the Conference on University Teaching of Computer Science*, (5), 285-292. https://bit.ly/48pJ7pA

Coccia, M. (2020). Deep learning technology for improving cancer care in society: New directions in cancer imaging driven by Artificial Intelligence. *Technology in Society*, *60*, 101198. https://doi.org/10.1016/j.techsoc.2019.101198

Ferreira, A., Salcedo, P., Kotz, G., & Barrientos, F. (2012). The arquitecture of ELE-TUTOR: An intelligent tutorial system for Spanish as a foreign language. *Signos Estudios de Lingüística*, *45*(79), 102-131. https://doi.org/10.4067/S0718-09342012000200001

Flores, F. A., Capuñay, D. L., Estela, R. O., Valles, M. Á., Vergara, E. E., & Elera, D. G. (2021). Artificial Intelligence in education: a review of the literature in international scientific journals. *Apuntes Universitarios*, *12*(1), 353-372. https://doi.org/10.17162/au.v12i1.974

Giró-Gracia, X., & Sancho-Gil, J. M. (2022). Artificial Intelligence in education: Big data, black boxes, and technological solutionism. *Revista Latinoamericana de Tecnología Educativa*, *2*(11), 129-145. https://doi.org/10.17398/1695-288X.21.1.129

Jalón-Arias, E. J., Molina-Chalacan, L. J., & Culque-Toapanta, W. V. (2022). Artificial Intelligence as an accelerator for the creation of teaching resources in higher education. *Conrado Journal*, *18*(S3), 8-14. https://bit.ly/3NZbNNR

Juca-Maldonado, F. (2023). The impact of Artificial Intelligence on academic work and research papers. *Metropolitan Journal of Applied Sciences*, *6*(S1), 289-296. https://bit.ly/48ohQnb.

Lengua-Cantero, C., Bernal-Oviedo, G., Flórez-Barboza, W., & Velandia-Feria, M. (2020). Emerging technologies in the teaching-learning process: Towards the critical thinking development. *Revista Electrónica Interuniversitaria Interuniversitaria de Formación del Profesorado*, *23*(3), 83-98. https://doi.org/10.6018/reifop.435611

Ocaña-Fernández, Y., Valenzuela-Fernández, L. A., & Garro-Aburto, L. L. (2019). Artificial Intelligence and its implications in higher education. *Propósitos y Representaciones*, *7*(2), 536-568. http://dx.doi.org/10.20511/pyr2019.v7n2.274

Peñaherrera, W., Cunuhay, W. C., Nata, D. J., & Moreira, L. E. (2022). Implementation of Artificial Intelligence (AI) as an educational resource. *Scientific Journal World of Research and Knowledge: Recimundo*, *2*, 404-413. https://doi.org/10.26820/recimundo/6.(2).abr.2022.402-413

Popenici, S., & Kerr, S. (2017). Exploring the impact of Artificial Intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning, 12*(1), 1-13. https://doi.org/10.1186/s4103901700628

Popescu, E. Badica, C., & Moraret, L. (2010). Accommodating learning styles in an adaptive educational system. *Informatica (Slovenia), 34*(4), 451-462. https://bit.ly/3SbJrlS

Razo-Abundis, Y., Dibut-Toledo, L. S., & Morales-Navarro, N. G. (2023). UGC plus platform: lifelong learning. *Revista UGC, 1*(2), 5-12. https://bit.ly/3NU1bjb

Rodríguez-Rodríguez, J., & Reguant-Álvarez, M. (2020). Calculating the reliability of a questionnaire or scale using SPSS: Cronbach's alpha coefficient. *REIRE Revista d'Innovació i Recerca en Educació, 13*(2), 1-13. https://doi.org/10.1344/reire2020.13.230048

Sanabria-Navarro, J. R., Silveira-Pérez, Y., Pérez-Bravo, D.-D., & Cortina-Núñez, M. D. (2023). Incidences of Artificial Intelligence in contemporary education. *Comunicar: Scientific Journal of Communication and Education, 31*(77), 97-107. https://doi.org/10.3916/C77-2023-08

United Nations Educational, Scientific and Cultural Organization (2019). *How Artificial Intelligence Can Strengthen Education.* UNESCO. https://bit.ly/3ROiVxJ

Urretavizcaya-Loinaz, M. (2001). Intelligent systems in the field of education. Inteligencia artificial. *Revista Iberoamericana de Inteligencia Artificial, 5*(12), 5-12. https://bit.ly/47Ai4qs

Veletsianos, G. (2010). Emerging Technologies in Distance Education. Marquis Book.

Wang, S., Yang, D. M., Rong, R., Zhan, X., Fujimoto, J., Liu, H., Minna. J., Wistuba. I. I., Xie, Y., & Xiao, G. (2019). Artificial Intelligence in lung cancer pathology image analysis. *Cancers, 11*(11), 1673. https://doi.org/10.3390/cancers11111673.

Yang, S. J., Ogata, H., Matsui, T., & Chen, N. S. (2021). Human-centered Artificial Intelligence in education: Seeing the invisible through the visible. *Computers and Education: Artificial Intelligence, 2*, 100008. https://doi.org/10.1016/j.caeai.2021.100008.

Zawacki-Richter, O., Marín, V.I., Bond, M. et al. (2019). Systematic review of research on Artificial Intelligence applications in higher education. Where are the educators? *International Journal of Educational Technology in Higher Education, 16*(1), 1-27. https://doi.org/10.1186/s41239-019-0171-0

13

Artificial Intelligence Tools for the Creation of Educational Videos for Teaching

PhD Carlos Hervás-Gómez
University of Sevilla, Spain
hervas@us.es
https://orcid.org/0000-0002-0904-9041

PhD María Dolores Díaz-Noguera
University of Sevilla, Spain
noguera@us.es
https://orcid.org/0000-0002-0624-4079

PhD Emilia Florina Grosu
Babes-Bolyai University, Romania
emilia.grosu@ubbcluj.ro
https://orcid.org/0000-0002-2846-9586

PhD Liliana Mâță
Vasile Alecsandri University of Bacău, Romania
liliana.mata@ub.ro
https://orcid.org/0000-0001-9293-3286

PhD Sonia Gabriela Neagu
Univeristatea Lucian Blaga Sibiu, Romania
soniagabriela.neagu@ulbsibiu.ro
https://orcid.org/0009-0000-3064-5537

María de los Ángeles Domínguez-González
Universidad de Sevilla, Spain
mariandg@us.es
https://orcid.org/0000-0002-9687-9325

Abstract
The use of Artificial Intelligence tools for the creation of educational videos is transforming teaching and learning. It is important to highlight the capacity of these tools to turn written content into attractive animated videos, thereby helping the students to understand the topics. The creative functions promoted by AI, such as text and image generation, color gradation and ultra slow-motion camera, offer new possibilities for the creation of educational content. These technologies not only foster creativity and imagination, but they also stimulate the interest of the students and motivate them to develop skills such as written expression and the construction of descriptive sentences. The dynamic and attractive creation of images and animated videos expands the creative options, enabling the exploration of new ways of presenting the educational contents. In a world at constant technological evolution, it is essential for teachers to make use of these tools to enrich the educational experience and prepare the students for a digitally competent future. As AI continues to evolve, its impact on education is expected to increase, transforming the way in which people teach and learn all over the world.

Keywords: Artificial Intelligence, APPs, educational video, emerging technologies.

13.1. Introduction

The history of humanity has been intrinsically linked to technological progress. From the dawn of prehistory, human beings have used technology, starting with basic tools like sharpened stones and sticks to hunt and ensure their survival, which allowed them to access food sources and protect themselves from the threats of their environment.

In time, technology continued to evolve, from the discovery of the wheel and the development of metal smelting, to the invention of the press and the steam engine. These technological developments were fundamental for the Industrial Revolution, which marked the beginning of a new chapter in the history of humanity.

The age of computers, which began in the mid-20th century, transformed the human capacity to carry out complex calculations. In the 1990s, the emergence of the Internet revolutionized the way in which people access information, purchase products and services and communicate, among other functions. A significant milestone in the last decades was the boom of mobile de-

vices, which have become an essential element of daily living. Nowadays, we are at the verge of a new technological revolution with the advance of Artificial Intelligence, which is expected to further transform our way of living and working.

13.2. Artificial Intelligence in Education

Throughout history, the use of technologies based on language has marked significant milestones, including: the invention of writing, which introduced the symbolic use of language; the press, which revolutionized the dissemination of knowledge, speeding it up and expanding its reach; and the development of computers, with their capacity to use binary language, which has been fundamental in the digital and technological era (Bozkurt, 2023).

Currently, a search in Google Academic using the terms "Artificial Intelligence in Education (AIED)" returns 4,490,000 results, demonstrating the vast influence and accelerated growth of this field, which is enhanced by its growing interest (Patel & Shahapurkar, 2021; Ilham et al., 2024).

Grassini (2023) pointed out that, in the last decade, technological advances have radically transformed educational practices. In particular, Artificial Intelligence (AI) has had a profound impact. The recent evolution of automatic learning has facilitated the creation of advanced digital contents, such as Generative Artificial Intelligence (GAI), which plays a significant role in education (Bozkurt et al., 2023).

AIED implies the use of computers and other types of devices to emulate, for example, aspects of human perception and decision making, with the aim of completing specific tasks. Essentially, AI encompasses processes through which machines identify complex factors and learn from them (Allam et al., 2023).

According to the European Commission (2022), AI has great potential to transform education, benefiting students, educators and managers of educational centers. Currently, AI helps to identify specific learning needs, offers personalized educational experiences, and facilitates the making of strategic decisions in educational institutions. AI manifests in both software (e.g., virtual assistants and search engines) and integrated technologies (e.g., robots and autonomous cars) (European Commission, 2022).

It is fundamental to analyze how AI can optimize the teaching-learning process and help education systems to make use of modern tools for the promotion of equity and educational quality (Allam et al., 2023).

As was stated by Domínguez-González et al. (2023), AI is redefining learning and remodeling the educational landscape (Naidu & Sevnarayan, 2023; Nipun et al., 2023). Jamal (2023) argued that, although AI offers great possibilities to improve teacher training and customize learning, it is fundamental to consider ethical, social, technical and cultural aspects, including concerns about privacy and bias (Jamal, 2023). Chat Generative Pre-Trained Transformer (ChatGPT) stands out as an influential technological development, which was trained to generate dialogues based on the requests of the users (Fergus et al., 2023). According to Naudi & Sevnarayan (2023), the efficacy of ChatGPT depends directly on the clarity and precision of the questions posed (Naudi & Sevnarayan, 2023).

AI has enabled a personalization of learning that was previously unreachable, thereby allowing the user to adjust the study content and pace to the individual needs, which favors a more effective learning and promotes diversity in the classroom (Istrate, 2019; Biswas et al., 2023). However, the integration of AI in education faces important challenges, including the concern that it may dehumanize education and the need to address it ethically, in order to prevent discrimination and protect the privacy of the students (Kerrigan et al., 2022).

The importance of Artificial Intelligence cannot be ignored in this era of innovation and transformation in many fields, including education (Ilham et al., 2024).

13.3. Artificial Intelligence Tools for the Creation of Educational Videos

This section presents some of the AI tools that allow creating educational videos.

Runway[1]

Runway is an AI-enhanced content-creation platform designed to facilitate content creation, edition and collaboration for the users. This tool offers a wide variety of creative functions enhanced by AI, such as text-to-image generation, erase and replace, AI training, text color gradation, ultra slow-motion camera, image-to-image generation, and infinite image. Furthermore, it has advanced video edition tools, such as green screen, image recovery and movement tracking.

By using AI models, Runway allows users to transform images and videos in a creative manner, even creating images from text messages. It simplifies tedious, repetitive and time-consuming tasks in the creation and edition of content, granting users full control over their creative projects. Likewise, it offers collaboration tools to facilitate the safe exchange of compositions, assets and content among teams. In addition, it provides a wide selection of professional templates that users may customize with only a few clicks.

Some of the educational possibilities provided by Runway are:

- Creative Tools for Design and Art: helps students and teachers explore new forms of digital creativity. It can be used in graphic design, digital art, and multimedia courses to teach students how to generate innovative images, videos, and visual effects.
- STEAM Education: By integrating science, technology, engineering, arts and mathematics (STEAM), Runway teaches complex concepts more visually and engagingly. Teachers use its capabilities to create simulations, data visualizations and 3D models that facilitate understanding complex topics.
- Project-based learning: It allows students to work on hands-on projects that require emerging technology, enhancing their technical and creative skills and fostering teamwork, problem-solving and critical thinking.
- Developing digital skills: In this society, familiarity with AI tools is crucial for students to learn the principles of Artificial Intelligence and machine learning, and how they apply in the real world, preparing them for the future.

1. https://runwayml.com/

- Personalised learning: It allows creating personalized educational materials adapted to each student's needs and learning pace. This is especially useful in inclusive and differentiated learning environments.
- International and multidisciplinary collaboration: Ease of use and online access enable collaborative projects between students from different disciplines and countries, fostering cultural exchange and interdisciplinary innovation.
- Up-to-date teaching: Teachers keep up to date with the latest technologies and teaching methodologies, integrating AI tools into their curriculum and pedagogical practices.

Fliki[2]

Fliki is an online platform that allows converting text or content from a blog into videos with AI-generated voices in a few minutes. The user simply enters a text or the URL of a blog, and this tool summarizes the content and selects the suitable images and videos to create a human voice-off video with customized subtitles.

With over 900 AI voices in more than 65 languages and 100 dialects, the user may choose the voice that best suits her/his audience and communication tone. Moreover, the script and the pronunciation of the text converted to voice can be edited.

Fliki also allows sharing content in different formats and platforms, such as YouTube, TikTok, Spotify and Instagram. The advantages of using Fliki for the creation of presentation videos include the capacity to generate videos from text or blog links with human voices and customized subtitles, the selection of a wide variety of languages, dialects and accents for the voice-over, the ease to edit the script and the pronunciation of the text converted to voice, the option of republishing the content in different formats and platforms, and the capacity to transcribe audio and video quickly and accurately.

The following are some of the educational possibilities provided by Fliki:

- Creating accessible educational content: Fliki can help teachers convert written lessons, course notes, and study materials

2. https://fliki.ai/

into audio and video content, making information more accessible to students with different learning styles, including those with visual impairments or reading difficulties.
- Supporting distance learning: It allows creating more engaging and personal course materials that complement existing digital resources.
- Promoting literacy and language: By supporting language and literacy learning, learners can hear the correct pronunciation and intonation of words and phrases in different languages.
- Enriching study material: Enriching study materials with audio narrations and explanations provides an additional resource that students can use to revise and reinforce their learning outside the classroom.
- Innovating in presentations and projects: More dynamic and interactive presentations and projects can be created, integrating voice narrations and videos. This improves students' presentation skills and allows them to experiment with new forms of creative expression.
- Access to diverse voices and languages: Fliki offers a wide range of voices and support for multiple languages, enabling the creation of inclusive and diverse educational content to suit different cultural and linguistic contexts.
- Feedback and Assessment: teachers can use Fliki to provide personalised verbal feedback to students on their work or to create oral assessments, which is beneficial in language courses or areas where verbal expression is critical.
- Learner autonomy: learners are empowered by being allowed to create their own learning resources, encouraging research, synthesis of information, and creativity. This promotes autonomous learning and the development of digital skills.

Steve AI[3]

Steve is an online platform for the creation of videos through AI technology that helps users in the development of professional-quality videos in only a few minutes. It was designed to satisfy the needs of any individual or company that requires producing videos quickly and simply, and it offers different applications,

3. https://www.steve.ai/

including the creation of invitation videos and the production of corporate content.

Some of the educational possibilities that Steve AI offers are the following: creating engaging educational content, fostering comprehension and retention, stimulating creativity and critical thinking, supporting multimodal learning, facilitating language learning, developing digital skills, innovation in presentations and projects, inclusive education, distance and online learning, collaboration and teamwork, etc.

Pictory[4]

Pictory is an AI-based platform that helps users to create professional-quality videos from full text, including archive material, music and voice-off. Thanks to its advanced AI technology, it simplifies the entire process, enabling the creation of professional videos effortlessly. It offers a wide range of templates and styles, as well as the possibility of personalizing and editing the video content, including tools to add text, images and music.

Pictory AI has several AI-mediated functions that increase the quality of the videos, including the automatic generation of subtitles to improve the accessibility and commitment of the audience, and the possibility of customising aspect ratios to adapt the videos to different platforms and formats, guaranteeing an optimal visualization in any device.

Moreover, it provides the option of selecting personalized voiceovers from a variety of natural options to add a professional narration. Users can also access a large library of music to complement their videos and establish the adequate tone. Likewise, Pictory AI allows improving videos with visual effects and animations, making them more interesting and visually attractive.

Some educational possibilities that Pictory offers are transforming curricular content into videos, fostering creativity and personal expression in students, supporting multimodal learning, improving reading comprehension and language, and facilitating distance learning, professional development and teacher training.

4. https://pictory.ai/

Invideo[5]

InVideo AI is an online video edition platform that stands out for its wide range of functions, options and tools designed to facilitate its use for digital content creation. To employ the text-to-video function of InVideo AI, the user introduces the key sentence or word to create the video. The tool analyzes the sentence and selects relevant images and video clips that will be incorporated into the final video.

Once the images and video clips are selected, the user can customize the content with text and music, using the different video and image templates available in InVideo AI. By generating a video with this platform, it is possible to add text, links to articles, images and videos directly. Depending on the desired option, the platform will automatically identify the key elements, questions and words that are relevant for the creation of a personalized video.

With regard to the topics addressed by InVideo AI, there are different categories, such as business, education, health, technology and tourism, among others, which allow creating videos for marketing, slide presentations, introductory videos, commercials, and content for social networks.

Some of the educational possibilities that InVideo AI provides are the following:

- Creating didactic material: Teachers can create a) concise and engaging video lessons to explain complex concepts, offering a visual alternative to traditional teaching methods, and b) videos summarizing the units or topics covered, providing students with a quick and effective review tool.
- Encouraging student participation through class projects and digital portfolios.
- Supporting distance learning. Creating rich video content for online courses or as a supplement to online classes can significantly enhance the distance learning experience, keeping students engaged and facilitating understanding of complex topics.
- Developing digital skills in media literacy and technological skills development.

5. https://ai.invideo.io

CapCut[6]

CapCut is a video edition application that allows users to express their creativity online through its characteristics and tutorials. The inclusion of AI-enhanced generative avatar functions, along with verification measures, significantly expands the edition capacities and strengthens the safety of the platform.

The integration of these new characteristics in CapCut helps users to verify their identities and employ AI-enhanced generative avatars to enrich their video edition experience. These functions can be combined with others, such as animation, filters and effects, to create original and exciting content.

To date, CapCut has introduced different smart tools, such as the removal of backgrounds in videos, automatic subtitles, and voice-to-text conversion, among others. These functions based on AI are greatly facilitating the video edition process for users.

Furthermore, CapCut users can make use of AI capacities to generate unique avatars, which increases the customization of their audiovisual content. By combining these new functions with the existing tools of the application, such as animation, layers and audio synchronization, the creativity and dynamism of the avatar function is potentiated. CapCut is constantly developing the digital avatar function, which facilitates the publication of videos that are verified in a simple manner.

Some of the educational possibilities that CapCut provides are the following: creating didactic content, fostering student creativity, collaboration and knowledge sharing, assessment and feedback, accessibility and inclusive learning, and teacher professional development.

Synthesia[7]

Synthesia is a tool that facilitates the creation of high-quality videos in a simple manner. This platform combines 3D animation with face-recognition technologies and language processing based on Artificial Intelligence, which results in the generation

6. https://www.capcut.com/es-es/tools/ai-video-generator
7. https://www.synthesia.io

of realistic "synthetic" characters whose appearance, sound and behavior are similar to those of real people.

Users can generate content using the predefined AI presenters of the platform or the AI generation function to create virtual versions of themselves, known as artificial reality identities. These avatars may narrate videos created from text, and the voice database of Synthesia offers a wide variety of gender options in more than 60 languages.

It is important to highlight that Synthesia forbids the use of its software to impersonate politicians or celebrities, requiring explicit consent and a thorough process of selection for the use of a person's image, with the aim of preventing possible misunderstanding.

Companies usually employ Synthesia more frequently for activities such as tutorials, training and presentations. This tool has been used for the creation of chatbots, reports, demonstrations of products and advertising campaigns.

The AI technology of Synthesia can be used to create realistic videos from scratch and to adapt existing audiovisual content, thereby offering a wide variety of creative and communication possibilities.

These are some of the educational possibilities provided by Synthesia:

- Creating customized learning materials: a) It can be used to create customized video lessons to explain complex concepts, providing a more interactive and engaging way of learning than traditional methods. b) The ability to generate videos in multiple languages facilitates the creation of accessible learning materials for students from different linguistic backgrounds, promoting inclusion and access to education.
- Encouraging student participation: a) Students can use Synthesia to create presentations of their projects, research or ideas, allowing them to focus on content without worrying about language barriers or stage anxiety. b) Through virtual avatars, students can participate in role-playing or decision-making scenarios, which is especially useful in areas such as ethics, business, and health.
- Improving accessibility: the integration of subtitles and the possibility of translating the text into different languages im-

prove accessibility for students with hearing disabilities or those who are not native speakers of the language of the course.
- Teacher professional development: by creating in-service training or professional development modules, allowing teachers to update their skills at their own pace and according to their specific needs.

Pictory AI[8]

The Pictory AI platform employs AI to produce high-quality videos, which makes it a especially beneficial tool for teachers, since videos are highly attractive resources for students of all ages.

Pictory AI allows saving time in the creation of educational content, generating videos in a matter of minutes. Its friendly interface facilitates its use, since AI does most of the work. Moreover, it allows narrating the videos with the user's own voice or AI-generated voices, which are quite realistic.

This platform offers different functions to create videos. It is possible to convert a script to a video with images, music and voiceover. By copying and pasting the script in the application, it generates images based on text without the need for manual edition. Furthermore, videos with voice can be edited using text, since, when uploading a video, the text is automatically transcribed, enabling adjustments in the text or the addition of voiceover. Thus, the user can modify existing videos or add narrations.

In addition, it is feasible to create videos from articles or blog publications, extract fragments of long videos to draw attention, and even add subtitles automatically to expand the reach of the content.

Thanks to its ease of use, it is possible to generate high-quality videos without the need of having advanced technical knowledge. The user can simply follow these steps: start by adding text, slides, or other videos, and then customize the background to give it a special and attractive touch; bring up the relevant text to highlight the key points and choose the voiceover that best suits the content, either with your own voice or with AI-generate voic-

8. https://pictory.ai/

es, which are very realistic; once completed, the video can be downloaded and shared in different formats.

Pictory provides the following educational possibilities: creating visual didactic content, enriching educational material, facilitating differentiated learning and teacher professional development by giving the user access to improved and visually appealing training material, etc.

Sora[9]

Sora, developed by OpenAI, is an AI system specialized in the generation of videos from text. As other systems of the company, such as ChatGPT and DALL-E, Sora is based on language model technologies like GPT. This system allows the users to describe what they wish to see in a video through text commands, which Sora interprets thanks to its training with a wide library of videos.

Sora is able to understand and recreate movements, complex scenes with multiple characters, detailed environments and visual effects requested by the users. For example, it can generate videos of an elegant woman walking in the streets of Tokyo full of neon lights and urban signs, accurately reflecting the clothing, accessories and environmental details described in the prompt.

In its initial development, Sora can create videos of up to 60 seconds, although OpenAI warns about possible limitations in the exact recreation of certain physics. The quality of the results generated by Sora depends on the clarity and detail of the descriptions provided in the text commands, which allows obtaining precise and customized results.

13.4. Discussion and conclusions

Nowadays, in the different actions that we carry out throughout the day, such as the way in which we communicate, learn, gather information and make decisions, everything revolves around AI (European Commission, 2022). It is part of our daily living (Aoun, 2017). At the general level, and according to the OECD (2019), AI is a general-purpose technology with the potential to:

9. https://openai.com/sora

improve the well-being of people; contribute to a positive, global, economic activity; increase innovation and productivity; and help to respond to the key global challenges (Bolatito, 2024). Arslan (2020) stated that AI is one of the most important technologies worldwide.

AI has reached omnipresence in daily living (Adiguzel, Kaya, & Cansu, 2023). A wide range of examples show that AI has permeated different aspects of human life, such as access to information through the Internet, the consumption of news and entertainment, face-recognition surveillance systems that identify people, the performance of financial markets, and the way in which drivers and pedestrians commute (Williamson & Eynon, 2020). As AI advances, the possibilities that were only notional may soon become tangible. A new application has been released recently, known as "Sora", which allows creating videos from text with exceptional quality. Therefore, AI has the potential to revolutionize the different aspects of society, from the business sector to healthcare and education (Alawi, 2023).

We use an increasing number of AI systems, sometimes without even noticing, such as search engines, smart assistants, conversation robots, language translation, navigation apps, online videogames, and many other applications that use AI in our daily living (European Commission, 2022).

Thus, we can state that AI is the ability of a machine to present the same capacities as human beings, such as reasoning, learning, creativity and planning (Arslan, 2020). That is, AI is the use of computer machines to think and act humanly and rationally (Allam et al., 2023).

Nowadays, it is fundamental for initial and continuing teacher training to include digital competences in the creation of educational videos with AI. It is recommended for future studies to expand the search for tools, due to the continuous advance of technology.

Acknowledgements

This study was financed by the VI Research and Transfer Plan of the University of Seville (VI PPIT-US), and it is part of the project entitled "Development of Skills in the Production of Education-

al Videos with Artificial Intelligence for Teaching: an Initiative for Initial teacher training (VIDIA-EDU)", within the 4th Teaching Plan of the University of Seville (Spain), Call for Support for Teaching Coordination and Innovation (ref. 221), Call 2023/2024.

References

Adiguzel, T., Kaya, M. H., & Cansu, F. K. (2023). Revolutionizing education with AI: Exploring the transformative potential of ChatGPT. *Contemporary Educational Technology*, *15*(3), ep429. https://doi.org/10.30935/cedtech/13152

Alawi F. (2023). Artificial Intelligence: The future might already be here. *Oral Surgery Oral Medicine Oral Pathology Oral Radiology*, *135*(3), 313-315. https://doi.org/10.1016/j.oooo.2023.01.002

Allam, H., Dempere, J., Akre, V., & Flores, P. (2023). Artificial Intelligence in education (AIED): Implications and challenges. In Johnston et al. (Eds.). *Proceedings of the HCT International General Education Conference (HCT-IGEC 2023), Atlantis Highlights in Social Sciences, Education and Humanities* (pp. 126-140). https://doi.org/10.2991/978-94-6463-286-6_10

Aoun, J. (2017). *Robot-Proof: Higher Education in the Age of Artificial Intelligence*. The MIT.

Arslan, K. (2020). Artificial Intelligence and applications in education. *Western Anatolia Journal of Educational Sciences*, *11*(1), 71-88.

Biswas, P., Sameem, M., & Mallick, L. (2023). Role of Artificial Intelligence in digital transformation of education. *Journal of Data Acquisition and Processing*, *38*(2), 985-989. https://doi.org/10.5281/zenodo.776668

Bolatito, A. S. (2024). The affordances of Artificial Intelligence on education. *Journal of Harbin Engineering University*, *45*(2), 76-85.

Bozkurt, A. (2023). Generative Artificial Intelligence (AI) powered conversational educational agents: The inevitable paradigm shift. *Asian Journal of Distance Education*, *18*(1). https://www.asianjde.com/ojs/index.php/AsianJDE/article/view/718

Bozkurt, A.; Xiao, J.; Lambert, S.; Pazurek, A.; Crompton, H.; Koseoglu, S.; Farrow, R.; Bond, M.; Nerantzi, C.; Honeychurch, S. (2023). Speculative futures on ChatGPT and generative Artificial Intelligence (AI): A collective reflection from the educational landscape.

Asian Journal of Distance Education, *18*(1), 53-130. https://doi.org/10.5281/zenodo.7636568

Domínguez-González, M. D. L. Á., Hervás-Gómez, C., Díaz-Noguera, M. D., & Reina-Parrado, M. (2023). Attention to diversity from Artificial Intelligence. *The European Educational Researcher*, *6*(3), 101-115. https://doi.org/10.31757/euer.633

European Commission, Directorate-General for Education, Youth, Sport and Culture (2022). *Ethical Guidelines on the Use of Artificial Intelligence (AI) and Data in Teaching and Learning for Educators*. European Union. https://data.europa.eu/doi/10.2766/153756

Fergus, S., Botha, M., & Ostovar, M. (2023). Evaluating academic answers generated using ChatGPT. *Journal of Chemical Education*, *100*(4), 1672-1675. https://doi.org/10.1021/acs.jchemed.3c00087

Grassini, S. (2023). Shaping the future of education: exploring the potential and consequences of AI and ChatGPT in educational settings. *Education Sciences*, *13*, 692. https://doi.org/10.3390/educsci13070692

Ilham, R., Giatman, M., & Maksun, H. (2024). Artificial Intelligence research in education: A bibliometric analysis. *Journal on Education*, *6*(2), 13467-13479. https://doi.org/10.31004/joe.v6i2.5199

Istrate, A. M. (2019). The impact of the virtual assistant (VA) on language classes. In *The International Scientific Conference eLearning and Software for Education*, 1, pp. 296-301. "Carol I" National Defence University, Bucharest

Jamal, A. (2023). The role of Artificial Intelligence (AI) in teacher education: Opportunities & challenges. *International Journal of Research and Analytical Reviews*, *10*(1), 140-146. https://ijrar.org/papers/IJRAR23A2629.pdf

Kerrigan, J., Cochran, G., Tabanli, S., Charnley, M., & Mulvey, S. (2022). Post-COVID changes to assessment practices: A case study of undergraduate STEM recitations. *Journal of Educational Technology Systems*, *51*(2), 192-201. https://doi.org/10.1177/00472395221118392

Naidu, K., & Sevnarayan, K. (2023). ChatGPT: An ever-increasing encroachment of Artificial Intelligence in online assessment in distance education. *Online Journal of Communication and Media Technologies*, *13*(1), e2023xx. https://doi.org/10.30935/ojcmt/13291

Nipun, M.S., Talukder, M.H., Butt, U.J., Sulaiman, R.B. (2023). Influence of Artificial Intelligence in higher education; impact, risk and counter measure. In H. Jahankhani, A. Jamal, G. Brown, E. Sainidis, R. Fong, U. J. Butt (Eds). *AI, Blockchain and Self-Sovereign Identity in*

Higher Education. Advanced Sciences and Technologies for Security Applications. Springer. https://doi.org/10.1007/978-3-031-33627-0_7

Organisation for Economic Co-operation and Development (2019). *Recommendation of the Council on Artificial Intelligence*. https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449, accessed 30 January 2024.

Patel V. D., & Shahapurkar G. (2021). Artificial Intelligence applications in higher education. *Journal of Advanced Research in Applied Artificial Intelligence and Neural Network, 5*(2), 5-9.

Williamson, B., & Eynon, R. (2020). Historical threads, missing links, and future directions in AI in education. *Learning, Media and Technology, 45*(3), 223-235. https://doi.org/10.1080/17439884.2020.1798995

14

"I learn better with Dall·E": Using Prompts for Self-regulation of Learning with Primary Education Pupils

PhD Celia Moreno-Morilla
Universidad de Sevilla, Spain
cmoreno8@us.es
https://orcid.org/0000-0003-0566-4319

Manuel Reina-Parrado
Universidad de Sevilla, Spain
mreinap@us.es
https://orcid.org/0000-0002-0801-0938

PhD María Navarro-Granados
Universidad de Extremadura, Spain
mariang@unex.es
https://orcid.org/0000-0001-7578-6659

Abstract
The proposed chapter examines the implementation of DALL·E3, an image-generating AI, as a tool for self-regulation of learning in Primary Education. This innovative methodology involves students in the creation of specific prompts to generate images, reflecting their conceptual understanding and application of knowledge. The process starts with instructing students on prompt formulation, reflecting their topic understanding. These prompts are input into DALL·E3, which then generates images based on these instructions. Analyzing these images helps students identify misunderstandings or learning gaps. The technique assumes that the clarity and accuracy of a student's prompt indicate their understanding level. This methodology incorporates constructivist learning theory, emphasizing active knowledge construction by the learner. By employing DALL·E3, students not only apply their knowledge but also partake in inquiry-based learning, exploring word-image relationships

and abstract concept representation. A pilot study with Primary Education students from Seville (Andalusia, Spain) gathers qualitative data to assess this tool's effectiveness in improving self-regulation and conceptual understanding. Results indicate an enhancement in students' learning self-regulation and motivation. The chapter also explores the pedagogical and ethical implications of using AI in educational contexts, highlighting both potential benefits and challenges. This research aims to provide insights into the use of emerging technologies in education and suggest directions for future research.

Keywords: Artificial Intelligence, DALL·E3, self-regulated learning, Primary Education, learning situation.

14.1. Introduction

This chapter describes a qualitative research experience incorporating the innovative technology DALL · E3 in the teaching of Primary Education. This Artificial Intelligence (AI) tool allows students to explore academic concepts through the generation of images from their textual descriptions (prompts), combining creativity and the interpretive capacity of natural language. The chapter reveals how this technology is integrated into the curriculum, enhancing visual learning, and stimulating student participation, which takes a central role in their learning process.

Through case studies, the literature review examines the effectiveness of this tool in promoting digital literacy and self-regulated learning. The chapter concludes with a series of conclusions and practical implications for the use of DALL · E3, providing an enlightening perspective on the challenges of incorporating AI tools into teaching. This narrative is an essential contribution for teachers interested in understanding and "navigating" the incorporation of emerging technologies in the Primary Education classroom.

Introduction to generative AI in education: DALL·E3

Generative AI, exemplified by advanced technologies such as DALL · E3, is marking an era of significant change in the field of education. These technologies are not only introducing new possibilities in terms of content and teaching methodologies, but they are also reshaping the way children learn. Aktay (2022)

delves into how these AI tools offer novel teaching and learning methods, highlighting their ability to adapt and personalize the educational experience. On the other hand, Cao & Dede (2023) explore the dynamics of these technologies in the educational context, arguing that generative AI can act as a catalyst for more interactive and participatory teaching strategies.

In addition, generative AI has been shown as a potential element to significantly enrich student engagement and learning, offering a more engaging and person-centerd approach (Siegle, 2023). The work of Vera (2023) and Gómez (2023) addresses how these technologies can transform pedagogical strategies, proposing a shift towards more creative and less traditional approaches to education. This shift is supported by the technical ability of generative AI to provide more personalized educational experiences tailored to students' individual interests and abilities (Fahimirad & Kotamjani, 2018).

Text-to-image AI has undergone a substantial shift in recent years with the launch of programs such as DALL·E3. These are AI models that combine linguistic comprehension with sophisticated visual capabilities. To generate the images, they use a two-stage approach. In the first, the model processes and encodes the textual descriptions or 'prompts'. In the second, it uses this encoding to generate visual images that closely correspond to the given description (French et al., 2023).

In this study, we focus on DALL·E3, (developed by OpenAI), whose main characteristic is the ability to interpret complex and abstract concepts provided in the text, creating visually appealing images that are highly faithful to textual prompts (Li, 2022). This makes it a powerful tool for creative exploration. The flexibility and precision of DALL·E3 open up new possibilities for teaching and learning in creative disciplines, pushing the boundaries of artistic expression (Stokel-Walker, 2022).

Generative AI: some examples of its application in schools

Generative AI offers novel teaching-learning methods that contribute to educational innovation. It has been shown to be particularly effective in formulating prompts for image generation. This application has been evidenced by Dehouche & Dehouche (2023), who have explored its potential in the context of visual

art education. It stands out for its ability to inspire creativity and offer novel visual tools, thus facilitating a deeper understanding of the concepts studied at the curricular level. In addition, French et al. (2023) and Lee et al. (2023) have extended its use to other educational settings. In the first research, they addressed its application in the development of educational games. They suggest that generative AI can enrich the learning experience in games, providing more complex and adaptive scenarios and graphics that respond to students' needs and abilities. This customization capacity improves student *engagement* and encourages deeper learning. On the other hand, Lee et al. (2023) explored the integration of generative AI in STEAM (Science, Technology, Engineering, Art, and Mathematics) classes. Their work demonstrates that AI can foster analytical and creative thinking in these areas, offering students tools to explore concepts and solve problems in innovative ways. Finally, Gattupalli et al. (2023) argue that AI can offer new perspectives in mathematics teaching. Their work suggests that generative AI can be used to create personalized mathematical problems and scenarios, adapting to students' skill and comprehension levels. In summary, the application of generative AI in education offers multiple benefits, including enhancing creativity, personalizing learning, and encouraging critical thinking.

Pedagogical impact of generative AI: a revolution in didactics?

Generative AI is now an emerging field that transforms instructional design and student learning (Xu & Ouyang, 2022). However, many teachers still do not know how to make a pedagogical use of it in order to have a positive impact on teaching-learning processes (Zawacki-Richter et al., 2019).

The teacher becomes a guide, facilitator, and collaborator throughout the process (Salas-Pilco et al., 2022), leading to a remodelling of teacher-student relationships. AI does not replace the teacher; it is one more resource that contrasts with the environment of a conventional classroom where the educator plays an authoritative role in the planning and timing of teaching in most contexts.

Students are no longer passive recipients of knowledge and are allowed to take the initiative in constructing it from a more

situated/real learning approach (e.g., The city is no longer unique, it is not the one that is represented on page "x" of the textbook. The city is now the one that the student creates from their mind). In accordance with cognitive constructivism, students are expected to actively engage the knowledge acquired and form novel conceptual structures on top of those already existing in their minds (Xu & Ouyang, 2022).

The classroom should become a space where humans and technology live intertwined in search of a more sensitive, fair, and sustainable educational process. Along these lines, Berson & Berson (2023) highlighted the democratizing potential of generative AI, arguing that it can facilitate more equitable access to education. It has the ability to personalize learning and provide adaptive teaching materials that respond to individual student needs, which could help close educational gaps and promote more inclusive education (Rodríguez-García et al., 2020).

Generative AI as a strategy for self-regulation of learning

In the contemporary field of education, the integration of AI into the process of self-regulation of learning represents a significant advance, marking a paradigm shift in how learning is facilitated and assessed. Self-regulation of learning, defined as the ability of students to direct and control their own learning process through self-assessment, goal setting, and strategic implementation of learning techniques, is crucial in the development of autonomous and competent learners (Zimmerman, 2008).

The study by Molenaar et al. (2023) highlights that AI, using multimodal and multichannel data, can measure and facilitate self-regulated learning. This approach allows for a more accurate and personalized assessment of the students' learning process. AI's ability to process large volumes of complex data in real-time enables a more adaptive and individual-centered educational response. On the other hand, Wang & Lin (2023) addressed the use of AI to analyze self-regulated learning from a human-centered perspective. Their approach underscores the importance of understanding self-regulated learning not only as a cognitive process, but also as an affective and social phenomenon. Finally, the work of Jones & Castellano (2018) provides a practical example of how AI, in the form of adaptive robotic tutors, can be

applied in the educational context to support self-regulated learning. In their research with primary school children, they show that robots can act as facilitators in the development of self-regulation strategies.

Overall, the literature shows the diversity of applications and the transformative potential of AI in the processes of self-regulation of learning.

In the light of the review carried out, we set two main objectives:

- OBJ-1. Exploring the potential of DALL·E3 in Primary Education.
- OBJ-2. To analyze children's attitudes towards the incorporation of this innovative technology.

14.2. Methodology

This experience responds to a collaborative research model, involving the teacher and students as active participants in the whole process (co-investigators) (Campbell & Lassiter, 2010).

Participants

The sample consisted of 25 students in the first year of Primary Education, with 12 boys and 13 girls aged between 6 and 7 years. These students are characterized by their dynamism, curiosity, and a remarkably positive attitude towards learning. Their disposition towards educational activities is proactive, showing a special interest in those that involve interaction and teamwork, which reflects the cooperative ideology of their school. Two participants had special educational needs and received support to facilitate their inclusion.

Information collection and data analysis

The study was carried out during the usual class hours, and the teacher adopted the role of co-researcher with the rest of the researchers of the university. The collection of information was organized in three sessions and took place during the month of

November 2023. Specifically, the efficacy of DALL · E3 was evaluated in the context of the subject of Knowledge of the Natural and Social Environment, which is taught in English under a bilingual program. At that time, the teacher was developing a learning situation focused on the differentiating elements of 'City' and 'Village'.

The sample of students was divided into five heterogeneous groups; they were asked to discuss the most important elements of a city, and then create a detailed description that would be used as a prompt in ChatGPT. The exercise consisted in each group drawing up a list of essential elements for a city, which would be included in a DALL · E3. The initial prompt, formulated by the teacher, was: "We are a first-grade class. We want an image of a city with the following elements: [...]". Each group added the concepts they had learned during the development of the Learning Situation.

Data collection was carried out as follows in the three stipulated sessions:

- **First Session**. The activity was introduced, and the groups were formed. The students discussed and agreed on the elements they wanted to include in their cities. The, the session was focused on the initial brainstorming and creation of the prompts for DALL · E3.
- **Second Session**. The students received the images generated by DALL · E3 and compared these representations with the examples of cities in their slides and textbooks. They identified areas for improvement and made a second correction to their prompts.
- **Third Session**. The session was focused on an in-classroom interview, where the students reflected on the learning process and expressed their opinions on the effectiveness of DALL · E3 as an educational tool. This session allowed us to gather detailed insights into the students' learning experience and their interaction with technology.

At the end of each session, the research group met to analyze the events and make the necessary modifications in the following sessions.

Participant observation in the classroom and audio recordings of the sessions were essential for their subsequent analysis.

The ten productions (cities) created by the students, together with the discourses generated during the creation process with DALL·E3, were analyzed to evaluate the effectiveness of the tool in the educational environment. This multifaceted approach provided a comprehensive understanding of the tool's impact on students' self-regulation of learning.

The children's participation in the research was voluntary and followed the ethical requirement of informed consent. At all times, the internal regulations of Social Sciences required by the Ethics Committee of Experimentation of the University of Seville were followed.

14.3. Results

Potentiality of DALL·E3 in knowledge of the environment (Objective 1)

In this research, the potential of DALL·E3 was assessed in the educational context, specifically in the subject of Knowledge of the Natural and Social Environment. Through the generation of images based on descriptions supplied by first-grade elementary students, we sought not only to understand AI's ability to create images that reflect learned concepts, but also to examine children's attitudes towards this emerging technology.

Based on the initial ideas that the students had demonstrated in class about the elements of the city and the town, the teacher created the following prompt: "We are a first-grade class. We want an image of a city with the following elements: [...]". Each group of students completed it with the concepts they had studied during the Learning Situation, resulting in five different images of cities (one per group).

Figure 14.1 shows a city closer to the image of a village, which made the students make observations such as: "the houses are very small", "there are many plants". This occurred as the group placed greater importance on items such as trees, houses, and fountains. It is considered that the group made a poor prompt of content, since they forgot other concepts learned during the Learning Situation closer to the image of an industrialized city such as factories and skyscrapers.

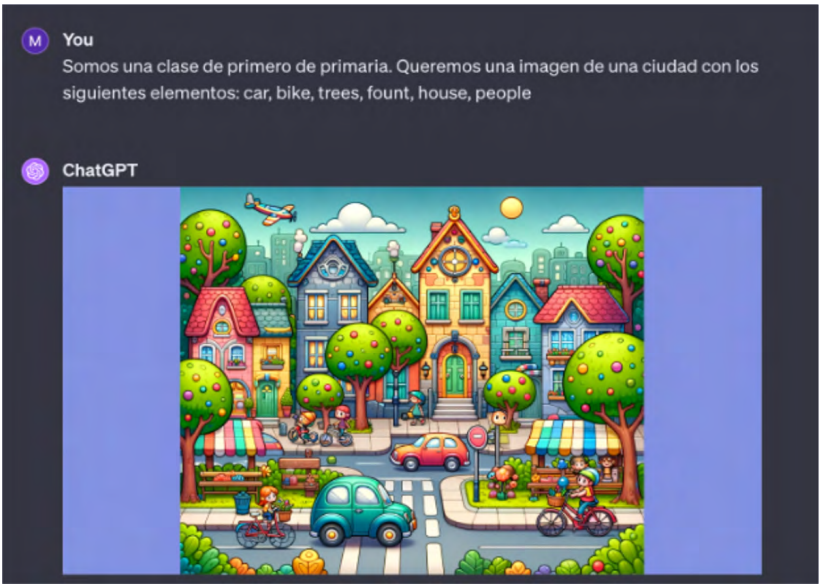


Figure 14.1. A city created from a deficit prompt. Source: developed by authors.

In the first attempt of each group, the results did not correspond to the idea of the city that they had, thus they were willing to try to improve: "We want to do it again, please", "We have to put a hundred cars to make it like Seville", "The houses are very small, like in my grandmother's village. The ones in Seville are bigger."

By making the corrections in a new prompt, through the addition of more concepts studied in the unit, the AI provided results closer to the students' concept of the city (Figure 14.2).

In some cases, as can be seen in Figure 14.2, the image had imperfections, such as the appearance of "birds" with strange shapes, which gave rise to debate: "The aliens have invaded the city", "The city is so cool! Let's see if there are aliens in ours too." Talking with the teacher, the students understood that, in order to create a realistic city, they could improve this prompt by indicating "Let the city be real, of this world", "Let the monsters be birds so that it is real".

However, the students were able to understand at all times that they were in front of cities, working on the concepts of the unit: "There are many cars", "There are traffic lights in the street", "There are many people", "The buildings are already big, they

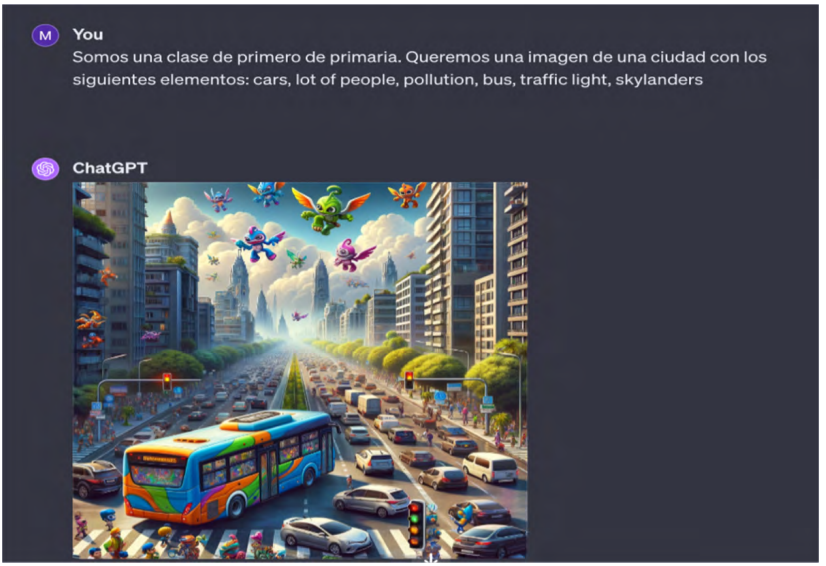


Figure 14.2. City created from a proper/complete prompt. Source: developed by authors.

weren't before", "The trees are like those in Seville", "The street is very big, it looks like the one next to the Betis stadium".

Students' attitudes towards the use of generative AI (Objective 2)

The introduction of DALL·E3 in the educational environment was shown in our study to be a valuable tool to promote self-regulation of learning among students. The results show that this form of AI goes beyond simple visual reproduction, prompting students to take a more active approach to their education. The class tutor comments: "The students have been more willing to explore for themselves without asking me many questions, which helps them to learn in a more autonomous and effective way."

The enthusiasm that the practice generated among the students is a clear indicator of its potential as a pedagogical resource: "Teacher, it's super cool to see how the city is being built with what we are telling you," said one student, reflecting the tool's ability to capture the attention of children. Another child

added: "I like using it, because I can make my real city [...], the city of the book is not my city." These reflections show the capacity of DALL·E3 to motivate students, encouraging their autonomous learning by focusing the content on elements that are familiar to them.

The experience of working with DALL·E3 showed that the imaging process is just as valuable as the final images themselves. The difference between what the students expected and what the AI produced opened up a space for them to reflect on their thinking and way of solving problems. The tutor observed: "The discussion that arises when the images do not match their expectations gives rise to a learning opportunity."

14.4. Conclusions and Practical Implications

The results obtained in the present study underline the significant potential of AI, particularly tools such as DALL·E3, to enable teachers to transform and enrich the educational environment. It was demonstrated that AI not only serves as a resource to complement the work of teachers, but it also enriches the learning process of students by facilitating an active construction of knowledge. The ability of this tool to promote self-regulation and inquiry-based learning highlights its pedagogical value, encouraging students to take a more active and focused role in their own learning process. This autonomy and personalization of learning manifests itself in greater motivation and empowerment among students.

In addition, the use of tools such as DALL·E3 demonstrates a sensitivity to cultural diversity, allowing students from different backgrounds to see themselves reflected and to integrate their environment and personal experiences into learning. The possibility of personalizing teaching-learning processes and conducting formative assessments in real time represents a significant step towards inclusive education. This approach not only improves students' commitment to their educational process, but also fosters a fairer and more equitable learning environment, where each student can progress according to their abilities and needs.

The tutor stressed that the use of DALL·E3 in the classroom should focus on stimulating students' imagination and curiosity

rather than chasing the generation of hyper-realistic images. This approach aligns with the perception that technology should serve as a catalyst for creativity and not just as a tool to replicate reality. For this reason, no major effort was made to refine or alter the prompt that led to the creation of Figure 14.2. However, at higher levels of education, where students have greater autonomy and ability to construct their own descriptions, it would be convenient to guide them towards the creation of prompts that more accurately reflect the structures and organization of a city.

The integration of AI tools in education also poses significant challenges that must be addressed to maximize their potential. The need for adequate teacher training, equitable access to technology, and adaptation of curricula are crucial aspects for successful implementation. In conclusion, this study underlines the importance of expanding the educational experience with AI to other courses and contexts, encouraging students to design their own prompts and actively participate in their learning process. The adaptation and expansion of these tools at different educational levels and areas of study is essential to prepare students for a digitalized future, fostering a more personalized, inclusive, and adaptive education to cover the needs of the 21st century.

References

Aktay, S. (2022). The usability of images generated by Artificial Intelligence (AI) in education. *International Technology and Education Journal*, *6*(2), 51-62.

Berson, I. R., & Berson, M.J. (2023). The democratization of AI and its transformative potential in social studies education. *Social Education*, *87*(2), 114-118.

Campbell, E., & Lassiter, L. E. (2010). From collaborative ethnography to collaborative pedagogy: reflections on the other side of Middletown Project and community-university research partnerships. *Anthropology & Education Quarterly*, *41*(4), 370-85. https://doi.org/10.1111/j.1548-1492.2010.01098.x

Cao, L., & Dede, C. (2023). *Navigating a World of Generative AI: Suggestions for Educators*. Harvard Graduate School of Education. https://bpb-us-e1.wpmucdn.com/websites.harvard.edu/dist/a/108/files/2023/08/Cao_Dede_final_8.4.23.pdf.

Dehouche, N., & Dehouche, K. (2023). What's in a text-to-image prompt? The potential of stable diffusion in visual arts education. *Heliyon*, *9*, 1-12. https://doi.org/10.1016/j.heliyon.2023.e16757

Fahimirad, M., & Kotamjani, S. S. (2018). A review on application of Artificial Intelligence in teaching and learning in educational contexts. *International Journal of Learning and Development*, *8*(4), 106-118. https://doi.org/10.5296/ijld.v8i4.14057

French, F., Levi, D., Maczo, C., Simonaityte, A., Triantafyllidis, S., & Varda, G. (2023). creative use of OpenAI in education: Case studies from game development. *Multimodal Technol. Interact.*, *7*(8), 81. https://doi.org/10.3390/mti7080081

Gattupalli, S., Maloy, R. W., & Edwards, S. (2023). Comparing Teacher-written and AI-Generated Math Problem Solving Strategies for Elementary School Students: Implications for classroom learning. College of Education Working Papers and Reports Series. https://doi.org/10.7275/8sgx-xj08.

Gómez, W. O. A. (2023). La inteligencia artificial y su incidencia en la educación: transformando el aprendizaje para el siglo XXI. *Revista Internacional de Pedagogía e Innovación Educativa*, *3*(2), 217-229. https://doi.org/10.51660/ripie.v3i2.133

Jones, A., & Castellano, G. (2018). Adaptive robotic tutors that support self-regulated learning: A longer-term investigation with primary school children. *International Journal of Social Robotics*, *10*(3), 357-370. https://doi.org/10.1007/s12369-017-0458-z

Lee, U., Han, A., Lee, J., Lee, E., Kim, J., Kim, H., & Lim, C. (2023). Prompt Aloud! Incorporating image-generative AI into STEAM class with learning analytics using prompt data. *Education and Information Technologies*, 1-31. https://doi.org/10.1007/s10639-023-12150-4.

Li, L. (2022). The impact of Artificial Intelligence painting on contemporary art from disco diffusion's painting creation experiment. *International Conference on Frontiers of Artificial Intelligence and Machine Learning* (pp. 52-56). FAIML https://doi.org/10.1109/FAIML57028.2022.00020

Molenaar, I., de Mooij, S., Azevedo, R., Bannert, M., Järvelä, S., & Gašević, D. (2023). Measuring self-regulated learning and the role of AI: Five years of research using multimodal multichannel data. *Computers in Human Behavior*, *139*, 107540. https://doi.org/10.1016/j.chb.2022.107540

Rodríguez-García, J. D., Moreno-León, J., Román-González, M., & Robles, G. (2020). LearningML: A tool to foster computational think-

ing skills through practical Artificial Intelligence projects. *Journal of Distance Education*, *20*(63), 1-37. https://doi.org/10.6018/RED.410121.

Salas-Pilco, S.Z., Xiao, K., &Oshima, J. (2022). Artificial Intelligence and new technologies in inclusive education for minority students: A systematic review. *Sustainability*, *14*, 13572. https://doi.org/10.3390/su142013572.

Siegle, D. (2023). A role for ChatGPT and AI in gifted education. *Gifted Child Today*, *46*(3), 211-219. https://doi.org/10.1177/10762175231168443

Stokel-Walker, C. (2022). AI bot ChatGPT writes smart essays. Should academics worry? *Nature*. https://doi.org/10.1038/d41586-022-04397-7

Vera, M.D.M.S. (2023). La inteligencia artificial como recurso docente: usos y posibilidades para el profesorado. *EDUCAR*, 1-15. https://doi.org/10.5565/rev/educar.1810

Wang, C. Y., & Lin, J. J. (2023). Utilizing Artificial Intelligence to support analyzing self-regulated learning: A preliminary mixed-methods evaluation from a human-centered perspective. *Computers in Human Behavior*, *144*, 107721. https://doi.org/10.1016/j.chb.2023.107721

Xu, W., & Ouyang, F. A. (2022). Systematic review of AI role in the educational system based on a proposed conceptual framework. *Education and Information Technologies*, *27*, 4195-4223. https://doi.org/10.1007/s10639-021-10774-y

Zawacki-Richter, O., Marín, V.I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on Artificial Intelligence applications in higher education: where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(39), 1-27. https://doi.org/10.1186/s41239-019-0171-0

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal*, *45*(1), 166-183. https://doi.org/10.3102/000283120731290

15

Automatic Short Answer Grading in Health Sciences with ChatGPT

PhD Nuria Padros-Flores
Universidad Miguel Hernández, Spain
npadros@umh.es
https://orcid.org/0000-0001-5206-8857

Ivan Gadea Sáez
Universidad de Alicante, Spain
ivan.gadea@ua.es
https://orcid.org/0009-0009-2290-3220

PhD Carolina Alonso-Montero
Universidad Miguel Hernández, Spain
c.alonso@umh.es
https://orcid.org/0000-0002-8856-1907

Abstract
Artificial Intelligence (AI) has emerged as a transformative tool in education, notably in facilitating automated exam grading. This study focuses on Automatic Short Answer Grading (ASAG) via ChatGPT-4, a widely accessible and versatile general-purpose generative AI model. We compare the grading outcomes from ChatGPT with those adjudicated by human evaluators within the health science domain. An evaluative framework was deployed to gauge the GPT-4 model's concordance with an expert educator's scoring. Human scores were compared to those offered by ChatGPT with different versions of prompts, specifically with 10 examples, 25 examples, and a grading rubric, employing a scoring metric that spans from 0 to 10 points, allowing for decimal values, without any model fine-tuning or parameter modulation. Our findings show that rubrics markedly enhance score alignment with an educator's evaluative benchmarks, registering intraclass correlation coefficients surpassing 0.8, thus nearly mirroring human judgment. These results suggest that there is ample scope for increasing the effectiveness of ASAG using Large Language Models

(LLM) such as ChatGPT. However, it is imperative to recognize that the operability of these systems is not yet fully reliable and stable, making human supervision necessary. The integration of expert supervision ensures both the accuracy and pedagogical validity of these automated tools.

Keywords: AI, ASAG, ChatGPT, health sciences, large language models.

15.1. Introduction

The emergence of ChatGPT as a universally accessible tool has popularized terms such as Large Language Model (LLM) and generative Artificial Intelligence (AI), enhancing public familiarity with these technologies (Leiter et al., 2023; Taecharungroj, 2023). LLMs are advanced AI systems capable of understanding and generating human-like text from the vast datasets on which they have been trained. This subset of generative AI technologies specializes in the production of coherent and contextually relevant content. In educational contexts, these models provide innovative approaches for the generation of dynamic learning materials and the delivery of personalized feedback. Other AI applications that are not aimed at content generation are focused on data analytics, predictive modelling and automation of task execution. Collectively, these diverse roles significantly contribute to the enhancement of teaching and learning experiences (Chen et al., 2020).

Recognizing the transformative potential of LLM in educational contexts, it is critical to address the dual-sided nature of their integration. Concerns such as preserving human-centric learning experiences, ensuring academic integrity, and managing copyright issues present significant challenges in an AI-enhanced learning environment (Ifenthaler & Schumacher, 2023; Preiksaitis & Rose, 2023). However, the unique capabilities of LLMs to generate contextually relevant and coherent text provide unprecedented opportunities for personalizing learning experiences, developing educational content, and providing automated feedback to students (Zawacki-Richter et al., 2019). Additionally, AI's incorporation into education promises to spur pedagogical innovation and enhance access to learning opportunities, particularly in geographically isolated or socioeconomically disadvantaged areas (Pacchiega, 2021).

The release of the GPT-3 model (Generative Pre-trained Transformer) in 2020 marked a significant advancement in AI research, although it was ChatGPT 3.5, launched towards the end of 2022, that really caught the public's attention with its greater accessibility and user-friendly interface. The development of GPT-3 incorporated reinforcement learning with human feedback, facilitating the creation of a powerful chatbot capable of understanding and generating responses to natural language prompts with unprecedented ease (Wu et al., 2023). Research on prompts soon began, uncovering that certain prompts work better than others in achieving specific responses (Cain, 2024; Henrickson & Meroño-Peñuela, 2023; Lee et al., 2023). The introduction of ChatGPT-4 further advanced the field by incorporating the ability to generate and analyze images. This enhancement established ChatGPT-4 as a leading chatbot with multimodal capabilities, pushing the boundaries towards achieving artificial general intelligence (AGI) (Wu et al., 2023).

The ease of use of these new generative AI tools has raised concerns among educators, particularly regarding the ease with which students can generate texts. Conversely, these technologies also present new opportunities for the automated assessment of exams and assignments. In educational settings, teachers often rely on various question types to evaluate student understanding, from multiple-choice questions, which can be automatically graded by specialized hardware, to short open-ended questions and essays that require more nuanced assessment. Specifically, Automatic Short Answer Grading (ASAG) is a field that has been of interest since the 1960s (Burrows et al., 2015).

Existing research in ASAG faces notable challenges. One limitation of current experiments is the use of limited evaluation categories, ranging from binary ("correct"/"incorrect") to more nuanced five-level scales ("very good" to "very bad"). To our knowledge, there is no ASAG model that numerically evaluates responses. This is understandable given that current linguistic models perform better with hierarchical labeling than with numerical ratings due to their text-based training. There are also certain cultural implications in this aspect. In addition, these models often overlook nuanced assessment styles unique to individual educators, which can undermine the unique assessment

perspectives they bring to their roles. Another major obstacle is the requirement for training examples for model effectiveness, posing a challenge when teachers wish to assess novel questions, requiring the labor-intensive creation of new training examples, comparable in effort to manual grading.

Among the most advanced ASAG models, the one proposed by Schneider et al. (2023) stands out. This model is based on multilingual transformers (BERT and LaBSE), which have been trained on a substantial dataset comprising approximately 10 million question-answer pairs across two classes. A notable feature of its contribution is its capacity for modulating the system's error tolerance –false positives and false negatives– delegating to the educators the correction of the items that pose the most doubts to the model. In contrast, the model introduced by Ormerod et al. (2023) is characterized by an ensemble of deep neural networks alongside a Latent Semantic Analysis-based model. In this model, holistic 2-point and 3-point rubrics were used, and special emphasis was placed on mitigating the biases inherent in machine learning models. In the domain of reading comprehension questions, Henkel et al. (2023) claim to be the first authors to announce an ASAG model, which matches or exceeds human evaluative performance. This model leverages the ChatGPT Application Programming Interface (API) and employs grading scales of 2 and 3 points.

The datasets currently available for ASAG research are not without their limitations. A primary constraint is the reliance on categorical rather than numerical grading, which is common to the aforementioned ASAG models. Moreover, the public nature of these datasets raises questions about their possible inclusion in GPT model training materials, a detail that the model developer has not publicly disclosed. Therefore, to safeguard the validity of our ChatGPT experiments, we decided to employ a novel, unpublished dataset, despite the resultant limitation in data quantity.

The search for reliable ASAG models is particularly relevant in the context of teaching overload and pursuit of more objective, consistent assessment methodologies. This quest takes on even greater importance in the field of distance education and is particularly crucial in the burgeoning context of Massive Open Online Courses (MOOCs), as highlighted by Y. Wang & Song

(2022). Manual grading, especially in courses with a large number of students, is often a laborious task prone to subjective bias (Campbell, 2015). This study seeks to examine the efficacy of LLMs to perform coherent grading aligned with teacher standards. Specifically, our intention is to test the capability of ChatGPT as an ASAG tool using a numerical rating and using the web interface. The rationale for employing ChatGPT-4's web interface in this investigation stems from its broad accessibility, user-friendliness, absence of additional model training prerequisites, and cost efficiency as an AI tool. While the API of ChatGPT-4 offers capabilities for fine-tuning certain parameters, such as the model's creativity tendency or "temperature"—a feature recommended to be set to 0 in this type of experiments by OpenAI, the corporation responsible for developing this model (Henkel et al., 2023)— this mode of operation requires programming knowledge, thereby limiting its accessibility. Since this kind of technical manipulation is beyond the reach of most teachers, this study opts for the more accessible web interface approach.

Advances in automated assessment systems have important implications for both operational efficiency and equity in the education sector, as they present a viable answer to a long-standing problem in pedagogy: providing rapid, comprehensive, accurate and equitable assessments.

15.2. Objective and Methods

The aim of this study is to evaluate the efficacy of ChatGPT-4 in numerically grading short open-ended questions within a specific field of Health Sciences, adhering to the assessment standards established by a subject matter expert. This involves comparing the grading outcomes of ChatGPT-4 with those determined by an educational expert in the discipline, across various types of input prompts. Such comparative analysis is instrumental in understanding the applicability and preparation of Large Language Models (LLMs) like ChatGPT for specialized grading tasks.

This research employs a mixed-methods comparative analysis to explore the congruence between ChatGPT's grading capabilities and those of an expert educator within the domain of Physi-

cal Podiatry. The participant cohort consisted of 62 Spanish undergraduate students, with all participants attempting the first question (Q1) and 59 addressing the second question (Q2). The teacher's grades for each of the questions were compared with 3 different prompts: one incorporating 10 examples, a second featuring 25 examples, and a third guided by a detailed marking rubric. The prompts had the following format:

> ACT AS AN EXPERT + TASK STEP BY STEP + EXPECTED OUTPUT + EXAMPLES OR EVALUATION CRITERIA + QUESTION TO EVALUATE

Furthermore, to augment the study's robustness, an external educator, not specialized in Physical Podiatry, was also asked to grade the two questions using the same rubric, offering an additional comparative perspective on the grading alignment. The assessments were conducted in January 2024 using ChatGPT-4, with responses graded on a 0 to 10 scale, allowing for decimal values, without any model fine-tuning or parameter modulation.

15.3. Results

To evaluate the congruence between measurements, we employed the Intraclass Correlation Coefficient (ICC) utilizing a two-way random effects mixed model, which assumes absolute agreement and single measurement by the rater. Additionally, we calculated the Quadratic Weighted Kappa (QWK) to facilitate comparison with other studies. It is important to note that the QWK must be applied to categorical data, requiring discretization of the continuous variables in our study to ensure its applicability. This dual approach (Table 15.1) allows for a detailed evaluation of ChatGPT's accuracy in performing ASAG tasks. This not only helps to elucidate the concordance among diverse grading methodologies but also establishes a solid framework for comparison with methodologies previously established in the literature.

Table 15.1. Comparison of the performance of different evaluators vs. the subject teacher

	Evaluator	Intraclass correlation coefficient Lower limit	95% Confidence interval		QWK
			Upper Limit		
Q1	GPT 10X	0.563	0.345	0.719	0.540
	GPT 25X	0.20	0.440	0.753	0.569
	GPT rubric	0.868	0.759	0.925	0.862
	Human	0.941	0.904	0.964	0.931
Q2	GPT 10X	0.697	0.539	0.808	0.698
	GPT 25X	0.621	0.438	0.756	0.616
	GPT rubric	0.828	0.621	0.913	0.829
	Human	0.859	0.679	0.929	0.861

Source: developed by autor.

15.4. Discussion

The findings of the present study provide empirical evidence of ChatGPT's ability to match educators' evaluation criteria in ASAG scenarios. This competence is not only apparent through the presentation of concrete examples but is more evident when the grading rubrics are clearly shown to the model at the prompt. Observations revealed varying levels of concordance between the assessments rendered by the expert educator and those generated by the GPT models. Utilization of a correction rubric in the prompts facilitated the achievement of elevated ICC values, registering 0.868 for Q1 and 0.828 for Q2, suggesting a significant congruence between the expert's evaluations and those proffered by ChatGPT. Although prompts based on examples yielded more modest outcomes, the outcomes remained robust.

Comparatively, the ICC values for the two questions graded by ChatGPT using a rubric (0.868 and 0.828) juxtaposed against the grades of a secondary human evaluator (0.941 and 0.859) demonstrate ChatGPT's proximity to mirroring the evaluative precision of an educator. This is in line with Henkel et al. (2023), who were the first to report a model capable of matching or ex-

ceeding human performance on ASAG tasks in reading comprehension contexts at elementary and middle school levels, also employing ChatGPT. Our outcomes are marginally inferior, which was predictable given the domain of the questions, aimed at a university level and outside the linguistic context for which the large language models have been trained and therefore perform better. Furthermore, it is important to consider that Henkel et al. (2023) designed their study using the ChatGPT API, thereby enabling control over certain variables to enhance model stability. The results obtained (0.89 and 0.92) in grading 2- or 3-class responses are very similar to those of our study using a continuous variable and rubrics (0.862 and 0.829), but superior to our experiments with examples, all below 0.7 QWK.

Recent research, such as that conducted by Ormerod et al. (2023), who implemented mixed models with specific training and rubrics, did not reach such high QWK coefficient values observed in our study, around 0.7. Nevertheless, the analysis revealed that the assessments produced by the model surpassed those executed by human evaluators using the identical dataset. Conversely, Schneider et al. (2023) report a maximal accuracy rate of 86.5% in binary grading (categorized as "correct" or "incorrect") using a model refined through training on millions of question-and-answer pairs, which would also be in line with our results.

A key observation from our study is that it is much more effective to teach the model our evaluative criteria rather than supplying it with examples for autonomous learning. Although this outcome was anticipated, the substantial magnitude of this effect was beyond our initial expectations. Indeed, the prompt designed for the correction of Q1 and Q2 provided with explicit instructions on the correction criteria, exhibited significantly superior performance (0.868 and 0.828), compared to the prompts incorporating either 10 examples (0.563 and 0.697) or 25 examples (0.620 and 0.621). Generally, the time investment required to generate 10 response examples exceeds that required to clearly define the correction criteria or to develop a rubric, and the results, as observed, are significantly better.

Furthermore, it was observed that the prompt with 10 examples for Q2 (ICC of 0.697) outperformed the prompt with 25 examples (ICC of 0.621). This suggests that there is a limit to the

number of examples that ChatGPT can effectively consider, and that exceeding this limit could deteriorate the overall performance of the model. To verify this hypothesis, it would be necessary to conduct a study specifically addressing this issue.

A qualitative review of the data generated by ChatGPT during the grading process revealed that, although the AI correctly reasoned the rationale for each assigned rating, discrepancies sometimes arose between its justifications and the resulting ratings. For instance, we identified situations where the model argued that a given response was superior to a certain example graded with a 3, yet lacked the comprehensive detail of other examples graded at 7. However, following this accurate argumentation, it awarded a grade of 3.5, closer to 3 than to 7, without observing that other examples rated with a 5 were more similar to the evaluated response. We also observed that, in the process of evaluating responses via the rubric, ChatGPT demonstrated computational inaccuracies on several occasions. Specifically, when segmenting the student responses to assign partial scores, we found errors in the addition or division operations required to obtain the final grade. In certain scenarios, the model generated and executed a small internal program for mathematical calculations, achieving accurate results thereafter. Despite these computational discrepancies, we adhered to a policy of non-intervention, upholding the model's final assigned grade, even in the presence of arithmetic errors.

Regarding the documented computational issues of ChatGPT with mathematics (Borji, 2023; Shakarian et al., 2023), the decision to implement a continuous scale from 0 to 10 for grading may have negatively impacted the model's performance. An assessment of ChatGPT's efficacy in grading complex university-level responses on a categorical rather than a numerical scale could facilitate a more congruent comparison with extant literature. Nonetheless, the aim of our study was to evaluate the model's capability to accurately process numerical data. We base this on the assumption that correct numerical data handling would likely enhance its performance in categorization tasks.

An additional limitation relates to the linguistic context of the assessment materials; the questions, answers, and prompts were presented in Spanish. Although the model can interpret and generate text in this language, the majority of its training corpus is in

English, which suggests that the results could improve if this language were used. To date, in our literature review we have not found any studies that specifically address the comparative performance of ChatGPT across languages. Given the global application of large linguistic models and the inherent linguistic diversity of users, understanding how ChatGPT's effectiveness varies by language is vitally important. This gap in the existing body of research presents a great opportunity for future research. Such studies would not only enrich our understanding of the linguistic capabilities of the model, but would also provide strategies for its optimization and application in multilingual contexts. Accordingly, we advocate the initiation of research aimed at evaluating ChatGPT's performance across a broad spectrum of languages, which would provide information of great value to the academic and technology communities.

In the course of our investigation, we identified specific instances where student responses resulted in an overestimation of grades by ChatGPT. For example, responses featuring extensive lists of technical terms—regardless of their accuracy—tended to be awarded higher grades compared to concise, error-free submissions. This phenomenon is consistent with findings from prior research, which has documented the susceptibility of LLMs to adversarial inputs that exploit model vulnerabilities (Filighera et al., 2020; J. Wang et al., 2023). Despite concerted efforts within the field, a robust solution to mitigate these types of adversarial attacks remains elusive.

Contrary to findings reported in other studies, our analysis did not reveal any biases in the text generated by the LLM (Acerbi & Stubbersfield, 2023), which may be attributable to the specific nature of the task assigned to ChatGPT and the evaluation context.

The systematic observation of ChatGPT to align with the grading standards of educators, even with a limited number of examples or a simple rubric, across both evaluated questions (Q1 and Q2), not only substantiates the methodological approach employed but also highlights the potential of LLMs as versatile and effective tools for educational assessment. This is especially pertinent in educational contexts, where the demand for efficiency is ever-increasing, and educators frequently face substantial workload challenges.

The significance of these findings extends beyond merely facilitating a reduction in educators' workload through the deployment of accessible and economically viable technological solutions. It also encompasses the enhancement of grading uniformity. Although the initial development of prompts with rubrics or multiple examples may incur substantial effort, this investment is marginal compared to the labor-intensive process of evaluating numerous student responses. Importantly, this approach fosters educational equity by mitigating the variability introduced by human assessors' fatigue, which can lead to inconsistent grading over time (Klein & El, 2003).

Importantly, ASAG models need not entirely replace educators in assessing student performance. Instead, AI can complement and support instructional efforts by offering alternative assessments, identifying grading inconsistencies, or preliminarily sorting responses to expedite the evaluation process. The results obtained suggest that such implementations could be applied in a wide range of educational contexts, providing scalable support to educators. This, in turn, could free up valuable time to focus on other aspects of teaching and allow for quicker and more personalized feedback for students.

The initial outcomes are indeed encouraging, but it is necessary to solidify them by conducting further comprehensive research across various academic disciplines and among different educator demographics. Future research should also focus on the mechanisms through which AI models interpret and apply grading criteria, examining these processes in light of existing evaluation theories and practices.

15.5. Conclusions

This research corroborates the hypothesis that LLMs, and particularly GPT series, represent the most promising approach in the ASAG field. These large language models are highly versatile and are capable of undertaking classification and grading tasks without needing specific prior training.

A significant finding of our research is that, to align with the teacher's grading style, a prompt with a rubric or a good description of the objectives sought by the teacher proves more effective

than providing the model with many examples. This approach not only simplifies and speeds up the process but also improves the outcomes. ChatGPT's ability to adapt to different evaluation styles underscores its potential as a transformative tool in educational assessment.

However, ChatGPT used via its web interface and without specific controls, can lean towards overly creative responses, yielding arbitrary grades, thereby constraining its utility as a universally applicable, unsupervised ASAG tool. It is also highly susceptible to mathematical calculation errors and adversarial attacks. Despite these challenges, its competence in grading complex health science answers at a human-equivalent level is remarkable. Future research should focus on how to effectively control this model to ensure uniform assessments.

In conclusion, the findings of this study, along with those of similar recent research, suggest that the way forward is the use of large language models with fine-tuning to achieve more accurate and stable grades.

References

Acerbi, A., & Stubbersfield, J. M. (2023). Large language models show human-like content biases in transmission chain experiments. *Proceedings of the National Academy of Sciences*, *120*(44), e2313790120. https://doi.org/10.1073/pnas.2313790120

Borji, A. (2023). *A Categorical Archive of ChatGPT Failures* (arXiv:2302.03494). arXiv. https://doi.org/10.48550/arXiv.2302.03494

Burrows, S., Gurevych, I., & Stein, B. (2015). The eras and trends of automatic short answer grading. *International Journal of Artificial Intelligence in Education*, *25*(1), 60–117. https://doi.org/10.1007/s40593-014-0026-8

Cain, W. (2024). Prompting change: Exploring prompt engineering in large language model AI and its potential to transform education. *TechTrends*, *68*(1), 47-57. https://doi.org/10.1007/s11528-023-00896-0

Campbell, T. (2015). Stereotyped at seven? Biases in teacher judgement of pupils' ability and attainment. *Journal of Social Policy*, *44*(3), 517–547. https://doi.org/10.1017/S0047279415000227

Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in education: A review. *IEEE Access*, *8*, 75264-75278. https://doi.org/10.1109/ACCESS.2020.2988510

Filighera, A., Steuer, T., & Rensing, C. (2020). Fooling automatic short answer grading systems. In I. I. Bittencourt, M. Cukurova, K. Muldner, R. Luckin, & E. Millán (Eds.). *Artificial Intelligence in Education* (pp. 177-190). Springer International. https://doi.org/10.1007/978-3-030-52237-7_15

Henkel, O., Hills, L., Roberts, B., & McGrane, J. (2023). *Can LLMs Grade Short-answer Reading Comprehension Questions: Foundational Literacy Assessment in LMICs* (arXiv:2310.18373). arXiv. https://doi.org/10.48550/arXiv.2310.18373

Henrickson, L., & Meroño-Peñuela, A. (2023). Prompting meaning: A hermeneutic approach to optimising prompt engineering with ChatGPT. *AI & SOCIETY*. https://doi.org/10.1007/s00146-023-01752-8

Ifenthaler, D., & Schumacher, C. (2023). Reciprocal issues of artificial and human intelligence in education. *Journal of Research on Technology in Education*, *55*(1), 1-6. https://doi.org/10.1080/15391523.2022.2154511

Klein, J., & El, L. P. (2003). Impairment of teacher efficiency during extended sessions of test correction. *European Journal of Teacher Education*,*26*(3),379-392.https://doi.org/10.1080/0261976032000128201

Lee, U., Jung, H., Jeon, Y., Sohn, Y., Hwang, W., Moon, J., & Kim, H. (2023). Few-shot is enough: Exploring ChatGPT prompt engineering method for automatic question generation in english education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-12249-8

Leiter, C., Zhang, R., Chen, Y., Belouadi, J., Larionov, D., Fresen, V., & Eger, S. (2023). *ChatGPT: A Meta-Analysis after 2.5 Months* (arXiv:2302.13795). arXiv. https://doi.org/10.48550/arXiv.2302.13795

Ormerod, C., Lottridge, S., Harris, A. E., Patel, M., van Wamelen, P., Kodeswaran, B., Woolf, S., & Young, M. (2023). Automated short answer scoring using an ensemble of neural networks and latent semantic analysis classifiers. *International Journal of Artificial Intelligence in Education*, *33*(3), 467-496. https://doi.org/10.1007/s40593-022-00294-2

Pacchiega, C. (2021). How can education use artificial Intelligence? A brief history of ai, its usages, its successes, and its problems when applied to education. In G. Panconesi, & M. Guida (Eds.). *Handbook*

of Research on Teaching with Virtual Environments and AI (pp. 558-590). IGI Global. https://doi.org/10.4018/978-1-7998-7638-0.ch024

Preiksaitis, C., & Rose, C. (2023). Opportunities, challenges, and future directions of generative Artificial Intelligence in medical education: Scoping review. *JMIR Medical Education*, *9*(1), e48785. https://doi.org/10.2196/48785

Schneider, J., Richner, R., & Riser, M. (2023). Towards trustworthy autograding of short, multi-lingual, multi-type answers. *International Journal of Artificial Intelligence in Education*, *33*(1), 88-118. https://doi.org/10.1007/s40593-022-00289-z

Shakarian, P., Koyyalamudi, A., Ngu, N., & Mareedu, L. (2023). An independent evaluation of ChatGPT on Mathematical Word Problems (MWP): *AAAI 2023 Spring Symposium on Challenges Requiring the Combination of Machine Learning and Knowledge Engineering*, AAAI-MAKE 2023. CEUR Workshop Proceedings, 3433. http://www.scopus.com/inward/record.url?scp=85166472786&partnerID=8YFLogxK

Taecharungroj, V. (2023). "What can chatgpt do?" Analyzing early reactions to the innovative AI chatbot on Twitter. *Big Data and Cognitive Computing*, *7*(1), Article 1. https://doi.org/10.3390/bdcc7010035

Wang, J., Hu, X., Hou, W., Chen, H., Zheng, R., Wang, Y., Yang, L., Huang, H., Ye, W., Geng, X., Jiao, B., Zhang, Y., & Xie, X. (2023). *On the Robustness of ChatGPT: An Adversarial and Out-of-distribution Perspective* (arXiv:2302.12095). arXiv. https://doi.org/10.48550/arXiv.2302.12095

Wang, Y., & Song, J. (2022). The success of Massive Open Online Courses (MOOCs): An investigation on course relevance. *Communications of the Association for Information Systems*, *51*(1). https://doi.org/10.17705/1CAIS.05131

Wu, T., He, S., Liu, J., Sun, S., Liu, K., Han, Q.-L., & Tang, Y. (2023). A brief overview of ChatGPT: The history, status quo and potential future development. *IEEE/CAA Journal of Automatica Sinica*, *10*(5), 1122–1136. https://doi.org/10.1109/JAS.2023.123618

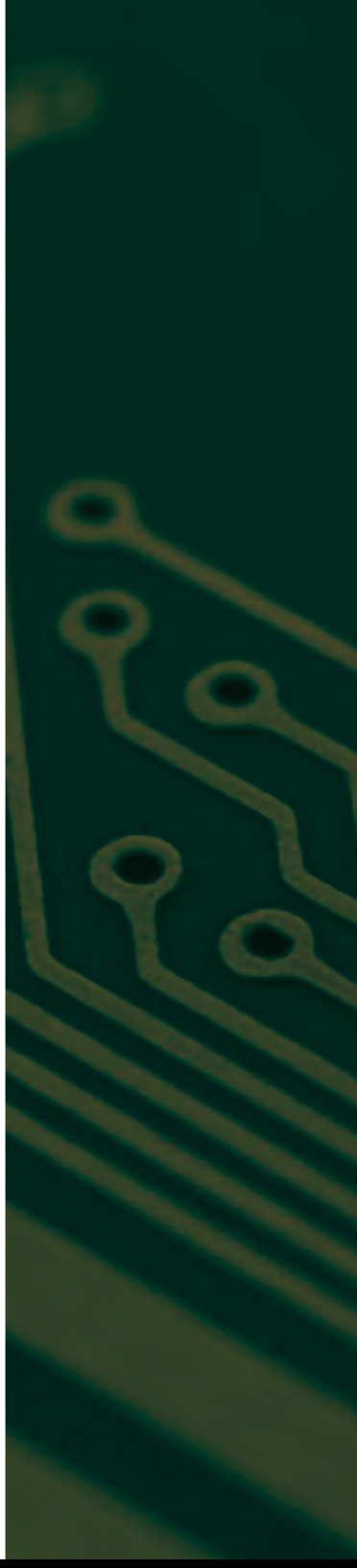
Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on Artificial Intelligence applications in higher education. Where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0

Index

The Education Revolution through Artificial Intelligence

Enhancing Skills, Safeguarding Rights, and Facilitating Human-Machine Collaboration

This book is a fundamental work that explores how AI is transforming the educational landscape. Through a critical and ethical lens, the authors address AI's potential to enhance skills, safeguard rights, and promote collaboration between humans and machines. From academic research to the creation of innovative educational content, this book provides a comprehensive guide for educators, students, and researchers in the digital age. It is a call to action for the conscious integration of AI into the education of the future.



Carlos Hervás-Gómez is a Full-Time Professor at the University of Seville (Spain), affiliated with the Faculty of Education Sciences in the Department of Didactics and Educational Organization. He teaches courses related to ICT. He is a member of the editorial boards of several journals, including the European Journal of Educational Research, International Journal of Educational Methodology, Journal of Research in Science, Mathematics and Technology Education, The European Educational Researcher, and Psychreg Journal of Psychology. His research focuses on the integration of ICT in teaching and learning processes through active and innovative methodologies, with a particular emphasis on emerging technologies and artificial intelligence in education.

María Dolores Díaz-Noguera is a Full-Time Professor in the Department of Didactics and Educational Organization at the University of Seville (Spain). Her teaching is closely linked to the disciplines of Educational Organization and Management. In recent years, she has made significant contributions to educational knowledge, with a particular focus on technology integration in education and educational inclusion. She has over twenty years of experience teaching doctoral courses at the University of Seville and other Andalusian universities, and has supervised numerous international doctoral theses.

Fulgencio Sánchez-Vera is an Assistant Professor in the Department of Didactics and School Organization at the University of La Laguna (Spain). He holds a PhD in Social and Cultural Anthropology from the University of Murcia, where he also earned a degree in Computer Engineering. Additionally, he has a Master's in Mindfulness from the University of Zaragoza and a University Expert title in Online Teaching from the International University of La Rioja. He has been a speaker at numerous courses on Educational Technology. Currently, he is the director of the journal "Cultura y Conciencia" and serves on the evaluation boards of various scientific journals. His scientific contributions include over fifty publications and participation in educational innovation and research projects, focusing on cyberspace, cyber culture, digital competence, and artificial intelligence in education.

Octaedro

Horizontes Universidad