LEARNING AND PARTICIPATION IN THE ZETA AND ALPHA GENERATIONS. EMERGING THEORETICAL PERSPECTIVES ON DIGITAL EDUCATIONAL POVERTY AND THE THIRD LEVEL OF THE DIGITAL DIVIDE

APPRENDIMENTO E PARTECIPAZIONE NELLE GENERAZIONI ZETA E ALPHA. PROSPETTIVE TEORICHE EMERGENTI SU POVERTÀ EDUCATIVA DIGITALE E TERZO LIVELLO DI DIGITAL DIVIDE

Serafino Murri[1]
University of International Studies of Rome
serafino.murri@unint.eu

Davide Scotta[2]
University of International Studies of Rome
davide.scotta@unint.eu

Salvatore Patera[3]
University of International Studies of Rome
salvatore.patera@unint.eu

Double Blind Peer Review

Citazione
Murri, S., Scotta, D., & Patera, S. (2024). Learning and participation in the zeta and alpha generations. Emerging theoretical perspectives on digital educational poverty and the third level of the digital divide. *Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva*, 8(2), Edizioni Universitarie Romane.

Doi:
https://doi.org/10.32043/gsd.v8i3.1137

gsdjournal.it
ISSN: 2532-3296
ISBN 978-88-7730-494-0

ABSTRACT
The paper problematises digital educational poverty with reference to the third level of the digital divide as a cultural distance between the learning and teaching modes of teachers and the Zeta and Alpha generations. The paper also examines the learning and participation modes of the new generations in the light of the emergencies posed by AI. Finally, a systematic review of the pedagogical literature provides recommendations for educational and didactic action on the subject.

Il documento problematizza la povertà educativa digitale con riferimento al terzo livello del digital divide come distanza culturale tra le modalità di apprendimento e insegnamento degli insegnanti e le generazioni Zeta e Alpha. Il documento esamina anche le modalità di apprendimento e partecipazione delle nuove generazioni alla luce delle emergenze poste dall'IA. Infine, una revisione sistematica della letteratura pedagogica fornisce raccomandazioni per l'azione educativa e didattica sul tema.

KEYWORDS
Digital educational poverty, digital divide, cultural models, artificial intelligence, systematic review
Povertà educativa digitale, digital divide, modelli culturali, intelligenza artificiale, revisione sistematica

Received 30/04/2024
Accepted 17/06/2024
Published 24/06/2024

---

[1] Serafino Murri wrote the paragraphs: "2", "2.1", "2.2", "2.3".
[2] Davide Scotta wrote the paragraphs "3.1", "3.2", "3.3".
[3] Salvatore Patera wrote the paragraphs: "Introduction", "1.1" "1.2".

Introduction

The conceptualisation of 'digital educational poverty' is attributed to CREMIT in 2022 for the report “Rewriting the Future” (Save The Children, 2021; Marangi, et al. 2022). The conceptualisation is derived from both DigComp2.1 (Carretero, et al. 2017; Vuorikari, et al. 2022) and the four dimensions for measuring educational poverty: learning to understand, being, living together, living an autonomous and active life.

In the context of this theoretical framework introduction, we problematise digital educational poverty because of the importance that can be attributed to other factors that contribute to the expansion of this phenomenon. In particular, we want to explore the 'cultural' nature of digital educational poverty in terms of the 'gap' that exists in the adult generations (parents, educators, teachers, etc.) in relation to the difficulty of understanding the patterns of signification and practices of digital cultural production and consumption of the younger generations. This is even more evident in formal educational contexts, where the cultural gap between teachers and students is a factor that not only aggravates the situation of digital educational poverty of the latter, but also hinders the acquisition of digital skills. In this respect, the results of ICILS 2018 (Invalsi, 2018) show that Italian students score significantly lower than the international average in terms of digital literacy.

In line with the DESI surveys (EC, 2018, 2022) and the findings of Istat reports (Istat, 2020), ICILS highlighted that three out of four students have a basic level of digital literacy, compared to 82% for the international average. Italian students say that they use computers less, both for school and non-school purposes, and also indicate that they learn mainly on their own or with peer support rather than at school or in the family. It should also be remembered that these surveys do not actually take into account and therefore do not assess the complexity of digital literacy, if not reductively with reference to mere digital skills and not to "mindsets, beliefs, values" as latent cultural factors that guide the way individuals act digitally in a competent manner (literacy) (Grange, Patera, 2021).

In short, the digital divide, as a cultural gap between the worlds of meaning that teachers and students operate in, adds to existing factors of inequality and creates new ones that increase the number and forms of educational poverty (Openpolis, 2020).

Starting from this snapshot, DigCompEdu (Caena, Redecker, 2019) highlights the priority challenges for the digital training of teachers in order to strengthen their ability to understand the exquisite cultural dimension that refers to the meanings associated with the use of technologies by the younger generations.

1.1 Digital educational poverty and the digital divide

Faced with this cultural pedagogical challenge for teacher training, it is necessary to problematise and demythologise a salvific conception of training aimed only at improving technicalities and, therefore, the use of technologies: in addition to the syntactic dimension of technological and digital language, the semantic dimension of this language should be considered in the intercultural dialogue between generations of teachers and students (Pattaro, et al. 2017).

However, with regard to the digital divide as a cultural divide, the training strategies on which initial teacher training is based and the consequent teaching strategies put into practice in the classroom are often insufficient, implicit and undersized to be able to bridge this divide as an intercultural dialogue between generations. In this sense, "La mera presencia de recursos tecnológicos en los centros y las altas capacidades de los alumnos de la «Generación Tecnológica» o «Generación Z», no son suficientes para desarrollar en los alumnos la competencia digital. La clave fundamental viene determinada por las competencias tecnológicas y pedagógicas de los docentes" (Fernández-Cruz, Fernández-Diaz, 2016, p. 97).

For the above reasons, the concept of digital educational poverty can be better understood according to what the scientific literature defines in terms of the three levels of the digital divide: the first level refers to the limited access to technologies and network infrastructures (Van Dijk, 2015), the second level to the reduced capacity to use technological and digital devices (Hargittai, 2002; Robinson, et al. 2003), i.e. the lack of "basic digital literacy", and the third level, the most relevant for the purposes of our theoretical positioning, which implies the absence of an effective and relevant learning-teaching strategy to promote competent digital action (Van Deursen et al. 2015; Pasta, Rivoltella, 2022; Patera, et al. 2023).

From this point of view, the reference goes «to the lack of acquisition of digital competences as new alphabets needed in the post-media society to analyse the production and fruition of different digital contents» (Pasta, Rivoltella, 2022, p. 601). In this sense, another aspect concerns the improvement of the digital skills of both students and teachers, as well as the strengthening of parental support towards a correct and conscious use of digital technologies. A possible key to interpreting the third-level digital divide as a factor affecting the increase in digital educational poverty, as taken up in another work (Patera, 2022), can therefore be the cultural divide, with reference to the existing and unexplored gap between students and teachers in terms of cultural models and thus representations and practices of teaching and learning in the digital context. This is due to the fact that the way of teaching and learning is also changing due to the centrality assumed by technologies for (Castro, et al. 2022; Fernández-Cruz, Fernández-Diaz, 2016). What is taking place is not only a technological and infrastructural change, but above all a cultural change that affects the way we teach and learn, how we know and communicate, how we give meaning and value to actions in life contexts, in the real world and in the digital world.

1.2 Digital divide as cultural divide: Open questions for teacher education

Overcoming the third level of the digital divide involves strengthening both the ability of teachers to recognise and act on the meanings hidden in the digital practices and artefacts produced by the younger generations, and the ability of students to grasp and re-elaborate the meanings associated with digital content in real and virtual contexts of learning and participation, so as to critically understand their significance in order to be guided towards competent digital action.

To sum up, this third level gap concerns, in a qualitatively deeper way, not so much and not only the competences attributed to basic digital literacy, which are in any case linked to the second level of the digital divide, but rather (digital) competent action in relation to the practices and meanings attributed to the use of technologies, to the underlying motivations, values, beliefs, dispositions to act and cultural models that guide the "how" of competent use of resources, in this case digital ones.

In pedagogical and didactic terms, the challenge for teachers is to understand and be able to recognise and value the patterns of signification, practices and digital artefacts produced by today's generations of learners (especially Zeta and Alpha) in order to overcome the third-level digital divide as a cultural divide: an intercultural educational challenge to reduce and, above all, prevent forms of digital educational poverty as a misrecognition of the identities of the younger generations (Castro, et al. 2020). As if to say that today's emerging issues related to the relationship between the younger generations and digital technologies (sexting, revenge porn, cyberbullying, cyber-harassment, internet gaming disorder, infodemia and fake news, hate speech, grooming, etc.) cannot but question the role of adults (educators, teachers, parents, etc.) insofar as the different forms of educational poverty represent, in a certain sense, the epiphenomenon of a more general cultural 'educational poverty'.), cannot but question the role of adults (educators, teachers, parents) in that the various forms of educational poverty are, in a sense, the epiphenomenon of a more general and cultural 'educational poverty' that is disarmed in recognising, taking charge of and addressing, from an educational point of view, the emergence of unexpected and unmet (digital) educational needs inside and outside school (Patera, 2023).

2. Theoretical positions on 'digital literacy': technology-enhanced learning and participation in the Zeta and Alpha generations.

2.1 Digital skills, personal competences and usage attitudes.

Possessing digital 'skills' does not mean overcoming 'digital literacy poverty' (Van Deursen, 2010): it is necessary to consider how these skills are culturally enacted as a function of representations, beliefs and values that characterise the processes of task signification and the relationship with context: how resources are orchestrated (Pellerey, 2004).

The focus on educational poverty, skills and the extent of the digital divide gets bogged down in the measurement of access and consumption of technologies (first and second levels), precluding the exploration of the complexity of the underlying factors (Grange, Patera, 2021), the "premises" (Mezirow, 1991), the representations and attitudes (mindset), the beliefs and values underlying the uses and meanings attributed to them (third level).

The increased use of devices does not lead to a proportional development of competences, even skills, nor does it benefit from them in terms of knowing how to act for life (learning to understand, to be, to live an autonomous and active life). Various studies show that high technology consumption contributes to the development of operational skills, but not to the development of critical skills in the selection, use and production of information (Skov, 2016).

A study conducted by Ala-Mutka (2008) shows that 19.5 per cent of respondents decided not to go to the doctor and 7.9 per cent decided not to follow his advice because of information found on the internet. Respondents who find information on the web may lack critical understanding of the content. The research suggests that digital literacy should be promoted and evaluated on the basis of what it enables or hinders in different areas of life (work, family, etc.). The domains of digital learning and school learning, on the other hand, follow parallel paths: students do not seem to perceive the digital medium as an interaction/integration of didactics, but rather as a tool to autonomously supplement curricular tasks (in separate spheres).

Personal digital competences' include: the ability to participate in the patterns of one's own reference groups (social media); 'community integration' as the recognition of belonging to shared problem areas (psychological, common cultural interests, etc.); Privacy and the identification of areas of content sharing/selection; critical understanding (knowing how to verify the validity of information); the ability to identify appropriate networks; the acquisition of specific skills (e.g., learning how to formulate prompts to communicate with AI); the healthy management of time in use; instances of 'visibility' (addressing content in platforms); economic discernment (quality/price assessment).

An under-explored nodal area concerns the “attitude of use” (Skov, 2016): the formulation of non-misunderstandable messages, the 'attribution of value' to communicative action, the ethics of sharing.
The ethical sphere is crucial for the expectations of use and rights/duties of 'digital citizenship': skills of citizenship, consumerism awareness, work and information acquired in the digital environment are resources that can be located in the didactic and educational sphere (Lave, 1988).

2.2 The Autopoietic and the Allopoietic Machine: Digital Subjectivity and the Structural Coupling with A.I.

From a cultural perspective, the models of signification and digital practices emerge from the specific 'structural coupling' (Maturana, Varela, 1980) between the autonomy of the body-mind as embodied mind (Varela, Thompson and Rosch, 1992) and the relative operational autonomy of the logical-cybernetic device of Artificial Intelligence (A.I.) that is developing in 'deep learning'.
A.I. is an operational output of digital devices (computers, smartphones, etc.), 'allopoietic' machines (Maturana, Varela, 1972) that organise static components (hardware) capable of expressing themselves in terms of processes (software) as 'non-autopoietic dynamic systems', i.e. subject to the discretionary use of the human 'autopoietic machine' (Maturana, Varela, 1972). The inter-functional coupling between the human mind and AI gives rise to a peculiar mind-body-emotional modality, irreducible to a relationship of "domination" of one over the other (Simondon, 1958), and exerting constitutive effects on both terms, giving rise to a "digital subjectivity" (Murri, 2020) specific to the mind interfaced with a device.
The relationship of digital subjectivity to virtual relationality in the 'Zeta' and 'Alpha' generations is also modelled on the expressive thrust of 'mass self-communication' (Castells, 2009): a private/public communicative modality whose main addressee is the same communicative actor, along a mirroring/self-feedback mechanism objectified on a double expressive level (endocommunicative and ectocommunicative), questioning the relationship between (self-)cognition, metacognitive abilities and the elaboration of meanings at the individual and social levels.
The 'intelligent' functioning of the algorithmic component of digital subjectivity follows an input-processing-output scheme (sensor-processor-actuator), the result of which must be predictable and replicable, and only relatively 'behavioural'. The AI can have compositional autonomy, but cannot reformulate the required action.
This characteristic establishes the "couplage" between the autonomous "existence" of the technical object and the individual (Simondon, 1958), with a

further heuristic value that leads the user to elaborate extensions of the acquired skills to different fields and problems.
In this sense, the narrowness of the "affordances" (Gibson, 1979) induced by the "templates" of the digital applications used (number of characters, duration of content, quality of prompts for the A.I., etc.) directs the modes of thinking towards certain "linguistic ideologies" (Aherarn, 2011) that affect the "deep structures" of language (Chomsky, 1964) as thought patterns and formulations of meaning underlying non-linguistic expression.
Even considering the large amounts of data (big data) available for data mining, the digital allopoietic machine acquires the sense of operating in the ambient world of the Web exclusively through the cognitive modes of self-behaviour that the 'non-trivial machine' of the human body-mind operates from the creative circle between motor and sensory that structures individual consciousness, tuning sensory-motor patterns of experience to emotional sensations with adaptive interaction (von Foerster, 1981).
The relationality between perception and internal representation allows the human mind to autonomously process information into thought images, with an 'autopoietic' 'reading' (Maturana, Varela, 1980).
This 'cognitive homeostasis', based on the relationship with the world-environment, distinguishes the operation of the human decision-making body-mind from the cybernetic operation (trivial machine) and also allows compatibility in functional coupling.
The 'objects' of human experience 'inhabit' the mind as dynamic memory images, temporary symbols of individual relational activities (von Foerster, 1981), which change as they acquire new sensory-motor data.
Deep learning, the computational learning 'autonomy' of A.I., simulates the functioning of the brain's neural networks by modelling the recognition and acquisition of data in order to reproduce artefacts, information and operations in a complex and accurate way, modifying the reading of data as new data is acquired in memory: in this sense the two 'machines' are analogous.
But AI only extends 'knowledge' quantitatively: the new 'experience' stored as an object to be labelled in order to be recalled when needed in the process is indeed a further datum of realisable possibility, but the quality of the product has no 'relational' aspect.
Thus AI can “operate intelligence” without thinking: it computes information, but has neither a self-conscious mind nor an emotional body to critically evaluate it. Operativity does not itself produce images that guide behaviour: 'generativity', separated from the body-hardware that produces it, operates a formal 'merging' of 'database images' and their comparison ‘without a proper reason’.
Another aspect of digital literacy concerns the use of the Web as a territory of self-education and parallel education, occupying cognitive and emotional energies once

devoted to activities in the presence: a 'space' of virtual enactment that compensates for the lack of infrastructures and cultural centres in the territory, as already mentioned on the subject of digital educational poverty (Patera, 2022). If the Internet is a 'territory' to be explored, its 'mapping' overturns the idea of 'centre' and 'periphery' in the topological ordering of the material world.

Acting on the Net takes place along a "communicative rhizome" (Deleuze, Guattari, 1980) that reflects the "world" in its causal-causal connections, even though this structure is not materially inserted into a pre-existing "terrain".

It is self-constituting in billions of daily paths from a small, dense and hyper-connected core, consisting of a hundred or so 'nodes' (of which Google is the most famous), surrounded by a vast region with a fractal structure, the 'peer-connected component' (S. Carmi, Sh. Havlin et al., 2007), at the edge of which orbits a weakly connected 'periphery'.

Such a structure makes it possible to go from one point of the 'peer-connected component' to any other in four links, without passing through the core: a horizontal interaction unimaginable in non-virtual life, which makes it possible to bypass 'official' documentation tools.

In pedagogical terms, this means that it is often the 'interconnected peers' who provide the information content rather than the node structures of the Net: a model of acculturation that makes peer education in the mode of 'self-communication' the daily engine of learning.

The "periphery" of the Internet is thus not a spatial concept, but a quantitative-qualitative one of connective experience: the limited capacity to multiply, select and differentiate networked experiences, with an active and critical use that allows one to refine, adapt and orient oneself within the explored peer-connected galaxy.

This experiential poverty concerns many "peripheral" users of the teaching body (Generation X, Millennials): this "digital agnosticism" is the origin of a prejudice in the digital native generations, who exclude from the educational relationship what they consider, obtorto collo, their own "digital intimacy" (Murri, 2023).

The participatory structure of the Web generates organic cognitive modes called "collective intelligence" (Levy, 1996), whose greatest limitation may be "interpassivity" (Žižek, 2013): being "active through the activity of the other".

The participatory condition in the network can best be defined as a form of "swarm intelligence" (Beni, Wang 1993): a collective behaviour of agents interacting locally that produces the emergence of global functional patterns in the system with limited individual capacities: ignorance of the global state of the system and in the absence of a coordinating entity.

A non-simultaneous mode of behaviour, comparable to the "stigmergic" communication typical of animal social structures, which takes place by changing the state of the environment in such a way as to influence the behaviour of other individuals for whom the environment itself is a stimulus (Kennedy, Eberhart, 2001).

2.3 I.A. in educational perspective: thinking processes, 'deep learning' and the relationship with the world-environment

The introduction of ChatGPT and DALL-E has had a major impact in attributing autonomous 'creative' qualities to A.I. (Bozkurt et al., 2023), requiring schools and universities to respond to the growing capabilities of generative A.I.
This has sparked a debate about the ethics, impact and value of A.I. in education, and governance and training need to address the speed and scale with which A.I. is able to transform teaching and learning (Bond, Khosravi et alii, 2024). Nevertheless, computational generativity cannot be seen as an autonomous replacement 'mode of thinking'. If thought consists of a 'flow of logically connected images' of a visual, auditory, gustatory, olfactory and somatosensory nature (Damásio, 1999), used by the mind as an interpretive-narrative device of experiential events (Bruner, 1990), this implies that the generative performance of AI in response to human stimuli, however complex, depends on the insertion of performative prompts that guide the output.
The cognitive 'growth' of the machine (deep learning) remains parasitical on the formulation of needs and demands that arise in the embodied mind of the user in its structural coupling with the world-environment. Such needs and wants in the form of 'input' determine the 'vision' of the A.I. A generative A.I. system applies non-supervised or self-supervised machine learning to data sets: but its capabilities depend on the modes and types of data sets used. Generative ‘deep learning’ engines are statistical models of the joint distribution of an observable variable and a dependent variable, known in data mining as the 'target variable'. They make it possible to extract and link content and ideas from the database that have not yet been structured in a given composition (scripts, images, videos, music), with a very high number of possible variations of the model, and to integrate extensions to the framework for real-time recognition and acquisition of data (images, sounds, etc.). However, innovation is part of the system criteria: it is possible to program generative algorithms to analyse complex data in a programmatically unconventional way, allowing researchers to develop trends, patterns and differentiated paths.
On an educational level, this possibility can be a resource for extending the potential of Intelligent Tutoring Systems (ITS) in the inclusive support of students with cognitive, social or emotional-psychological disadvantages.
The implementation of a tutoring system that is "transversal" to traditional pedagogical approaches and the adoption of new methodological and didactic perspectives can open up an innovative direction of educational intervention,

especially if it is supported by affective computing (Picard, 1997): softwares that enable different types of devices to detect, interpret and process emotions in the context of use, regulating the modes of interaction with the user. Affective computing proves to be effective in "translating" the bodily language of students with special educational needs as partners in a co-construction of meaning: a "reading bridge" of emotional, cultural and cognitive instances, according to which the subject expresses itself in its diversity (Bonavolontà, et al. 2023). In this sense, affective computing in the educational relationship can become a frontier of experimentation towards inclusivity (Murri, 2022).

3. Educational and teaching challenges from the main recommendations in the A.I. literature.

3.1 Introduction to the analysis

The introduction of AI in education opens up a wide range of opportunities and challenges, as highlighted in the first two paragraphs.

In this context, recent scientific literature is systematically reviewed to outline these challenges and corresponding recommendations for a beneficial integration of AI in education in the light of the findings in the previous paragraphs. Despite the growing awareness of the potential of AI, there has recently been a shift from laboratory work to classroom practice (Bond M., et al. 2024), which has raised concerns about the impact on students and teachers. The increasing number of freely available A.I. chatbots (Google's Bard3 and LLaMA4, ChatGPT, DALL-E,2) has disrupted the world of education (Bozkurt et al., 2023).The speed at which A.I. is transforming teaching and learning has opened up a debate about the impact and added value of A.I. (teacher training, ethics, regulation, etc.). Indeed, governments around the world are taking action to respond to this evolving phenomenon (European Parliament, 2023).

3.2 Materials and methods

For the purposes of this analysis, the PRISMA statement was used as a strict guideline for reporting systematic reviews with or without meta-analysis. The systematic review conducted here aims to summarise the state of the art and outline key recommendations from the literature on AI over the last eight years, in order to identify critical issues, strengths and risks of use in education and training contexts (Page et al., 20-21). The following databases were used GOOGLE SCHOLAR, EBSCO, ERIC, SCOPUS. The following combined keywords were used in the search Systematic Review AND (AI OR Artificial Intelligence) AND (Education OR Didactics) AND (School).

Inclusion criteria

- Studies published in English;
- Field of study: Artificial Intelligence and teaching in non-university education;
- Unit of analysis: Systematic reviews with or without meta-analysis and peer review;
- Time frame: Studies produced between 2017 and 2024;
- Search term and correspondence of units of analysis to selected keywords. We included any form of evidence synthesis as the aim of this review was to map the field, regardless of the secondary search approach used.

All types of results were included, such as reviews, brief reports, comparative studies and qualitative and quantitative methods. The search initially produced a list of 344 units of analysis.

Exclusion Criteria

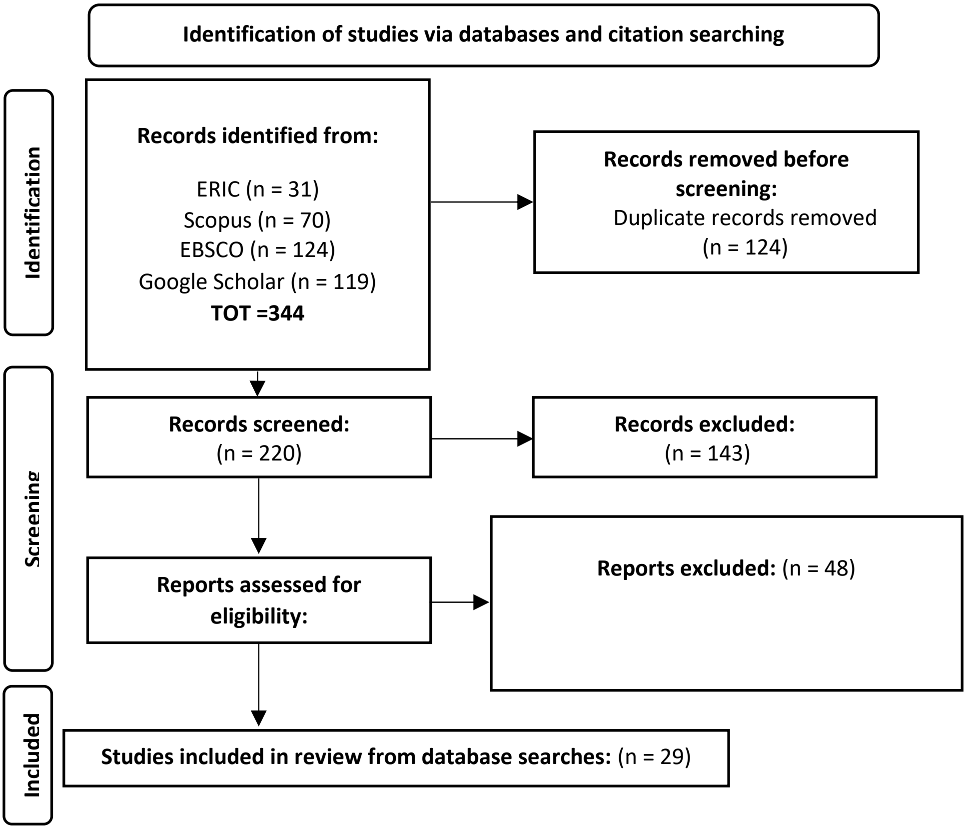
Units of analysis:

- Interim reports, research in progress, first level empirical research;
- with only a few keywords;
- related to the university environment;
- in languages other than English;
- lacking a peer review process;
- produced before 2017.

After removal of duplicates, the number of records screened was reduced to 220 analysis units.

After screening, 77 analysis units were selected for full-text review and 29 were selected for the comparison phase (Figure 1).

Fig. 1 (Research procedure)



3.3 Outcomes

The following themes emerged from the analysis of the scientific articles in Figure 1 regarding the areas in which AI is having an impact in educational contexts *Personalisation of learning, predictive analytics and intelligent tutoring* to create personalised learning experiences for each student, according to their needs and learning styles.

Automated assessment of student work, with immediate and detailed feedback.

Automation of administrative tasks associated with teaching and learning.

Conclusions

The results of the study provide clues, but also suggest caution in dealing with 'digital educational poverty' due to the changes that have occurred, as in the case of the emergencies posed by AI.

In fact, among the main indications, algorithmic *bias* and ethics are particularly important. The algorithms used can introduce biases that hinder educational fairness. At the same time, the hyper-personalisation produced by A.I. can widen the gap in learning opportunities between students from different socio-economic backgrounds. In addition, AI requires a core skill set to implement effectively, which not all education professionals possess. This is in addition to the issue of the partial replacement of the teacher by intelligent technologies, which raises questions about the future role of the teacher in the educational process (Schwab, 2018).

Another challenge is the protection of students' privacy, which arises from the use of data for educational purposes.

Ultimately, AI feeds on data and its careless use can lead to privacy violations for detailed student profiles that violate the fundamental right to privacy (Zuboff, 2019).

The literature reviewed suggests a multidisciplinary approach to research, pedagogical reflection and educational action, involving not only educators and technologists, but also students and parents in a constructive dialogue aimed at maximising the benefits of AI while minimising its risks.

Recommendations

This section contains 6 categories of recommendations for educational and didactic action, based on the main findings of the articles examined:

1. Understand the impact of AI on education
- Recognise the potential of AI to enhance learning and teaching.
- Be aware of the challenges and risks associated with AI.
- Develop a critical understanding of AI

2. Develop teaching skills in the use of AI.
- Learn to use AI-based teaching, design and assessment tools.

3. Design and implement A.I.-based teaching interventions by personalising learning.

4. Promote equity and inclusion
- Using AI to identify and address learning gaps with accessible technologies

5. Developing skills for the future
- Teach students critical thinking and problem solving skills.
- Prepare students for the jobs of the future by encouraging lifelong learning.

6. Empowering students

Give students control over their own self-directed learning.

References

Ahearn, L. M. (2011). *Living languages: an introduction to Linguistic Anthropology,* Wiley-Blackwell.

Ala-Mutka, K. (2008). Social Computing: Study on the Use and Impacts of Collaborative Content IPTS Exploratory Research on the Socio-economic Impact of Social Computing: Institute for Prospective Technological Studies, Joint Research Centre, European Commission.

Beni, G., & Wang, J. (1993). *Swarm intelligence in cellular robotic systems*, in Dario P., Sandini G., Aebischer P. (eds.), *Robots and biological systems: towards a new bionics?*, pages 703–712. New York: Springer.

Bonavolontà, G., et al. (2023). Technology and Accessibility in an Inclusive Perspective: Challenges, Opportunities and Educational Implications. *Italian Journal of Special Education for Inclusion*, XI, 2, 73-83.https://doi.org/10.7346/sipes-02-2023-07.

Bond, M., Khosravi, H., De Laat, M., Bergdahl, N., Negrea, V., Oxley, E., Phnam, P., Chong, S. W. & Siemens, G. (2024). A meta systematic review of artificial intelligence in higher education: a call for increased ethics, collaboration, and rigour. *International Journal of Educational Technology in Higher Education*, 21(4). https://doi.org/10.1186/s41239-023-00436-z.

Bozkurt, A., Xiao J., Lambert, S., Pazurek, A., Crompton, H., Koseoglu S., Farrow, R., et al. (2023). Speculative futures on ChatGPT and generative Artificial Intelligence (AI): A collective reflection from the educational land- scape, *Asian Journal of Distance Education*, 18(1), 1–78. http://www.asianjde.com/ojs/index.php/AsianJDE/article/ view/709/394.

Bruner, J. (1990). *Acts of meaning*. Cambridge: Harvard University Press.

Caena, F., & Redecker, C. (2019). Aligning teacher competence frameworks to 21st century challenges: The case for the European Digital Competence Framework for Educators (DigcompeDu), *European Journal of Education* 54, 356–369.

Carmi, S., Havlin, Sh., Kirkpatrick, S., Shavitt, Y., & Shir, E. (2007). A model of Internet topology using k-shell decomposition**,** *PNAS, 104* (27) https://www.pnas.org/doi/full/10.1073/pnas.0701175104#acknowledgments.

Carretero, S., Vuorikari, R., & Punie, Y. (2017). DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use, *European Commission's Joint Research Centre*, http://europa.eu/!Yg77Dh .

Castells, M. (2009). *Communication Power*, Oxford: Oxford University Press.

Castro, A., Patera, S., & Fernández, D. (2020). ¿Cómo aprenden las generaciones Z y Alpha desde la perspectiva docente? Implicaciones para desarrollar la competencia aprender a aprender. *Aula Abierta*, *49*(3), 279–292, https://doi.org/10.17811/rifie.49.3.2020.279-292.

Chomsky, N. (1964). *Current Issues in Linguistic Theory*, The Hague: Mouton.
Damásio, A. R. (1999). *The Feeling of What happens. Body in the Making of Counsciousness,* Boston: Mariner Books
Deleuze, G., & Guattari, F. (1997). *Rizoma. Mille piani. Capitalismo e schizofrenia-* sez.1, Castelvecchi, Roma.

European Commission (2018). *Digital Economy and Society Index (DESI)*, https://ec.europa.eu/information_society/newsroom/image/document/2018-20/it-desi_2018-country-profile_eng_B4406C8B-C962-EEA8-CCB24C81736A4C77_52226.pdf.

European Commission (2022), *Digital Economy and Society Index (DESI)* 2022, https://digital-strategy.ec.europa.eu/it/node/9773.

European Parliament, (2023). https://www.europarl.europa.eu/news/en/headlines/society/20230601STO93804/eu-ai-act-first-regulation-on-artificial-intelligence.

Fernández-Cruz, F.J., & Fernández-Diaz, J. (2016). Generation Z's Teachers and their Digital Skills. *Comunicar*, *46*(24), 97-105.

Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston: Houghton Mifflin.

Grange, T., & Patera, S. (2021). La valutazione formativa per sostenere lo sviluppo della dimensione profonda dell'agire competente. Un caso di studio, *Education Sciences & Society*, 2: 47-61.

Hargittai, E. (2002). Second-Level Digital Divide: Differences in People's Online Skills. *First Monday*, *7*(4), https://doi.org/10.5210/fm.v7i4.942.
Hattie, J. (2009). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. London: Routledge.

Invalsi, (2018). https://www.invalsi.it/invalsi/ri/Icils2018/documenti/Sintesi%20dei%20risultati%20italiani-ICILS%202018.pdf.

Istat, (2020). *Spazi in casa e disponibilità di computer per bambini e ragazzi*, https://www.istat.it/it/files//2020/04/Spazi-casa-disponibilita-computer-ragazzi.pdf.

Kennedy, J., & Eberhart, R. C. (2001). *Swarm Intelligence*. Burlington: Morgan Kaufmann Publishers.

Lave, J. (1988). *Cognition in Practice: Mind, Mathematics and Culture in Everyday Life*. Cambridge: Cambridge University Press.

Levy, P. (1996). *L'intelligenza collettiva. Per un'antropologia del cyberspazio*. Milano: Feltrinelli.

Marangi, M., Pasta, S. & Rivoltella, P.C. (2022). Povertà educativa digitale: costrutto, strumenti per rilevarla, risultati. Abstract del *Convegno SIREM 2022 Apprendere con le tecnologie tra presenza e distanza,* (Roma, Università Pontificia Salesiana, 31-August 02-September 2022) Brescia: Scholé - Morcelliana, pp. 23-26.

Maturana, H.C., & Varela, F.J. (1972). *De maquinas y seres vivas. Una teroia sobre la organización biológica*. Santiago, Chile: Editorial Universiaria.

Maturana, H. C., & Varela, F.J. (1980). *Autopoiesis and Cognition: The Realization of the Living.* New York: Springer.

Mezirow, J. (1991). *Transformative dimension of adult learning*. San Francisco: Jossey Bass.

Murri, S. (2020). *Sign(s) of the Times. Pensiero visuale ed estetiche della soggettività digitale*. Milano: Meltemi.

Murri, S. (2022). *Dalla "soggettività digitale" all'affective computing: sfide e prospettive di una "inclusività digitale"*, in F.P. Romeo (ed.), *Corpo e metafore per l'apprendimento esperienziale. Progetti, pratiche e studi di caso.* Milano: FrancoAngeli, pp. 63-78.

Murri, S. (2023). *"*Povertà educante": le periferie immateriali della relazione educativa al tempo della "platform society" e del pensiero visivo diffuso*",* in S. Patera (ed.) *Povertà educativa. Punti di riflessione e traiettorie di intervento – 2023*, Perspectives on rural development, 7,129 – 158.

Openpolis, (2020). www.conibambini.org/wp-content/uploads/2020/07/Disuguaglianze-digitali.pdf.

Page, M. J., McKenzie, et al., (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ (clinical Research Ed.), 372*, n71. https://doi.org/10.1136/bmj.n71.

Pasta, S., & Rivoltella, P.C. (2022). Superare la "povertà educativa digitale". Ipotesi di un nuovo costrutto per la cittadinanza digitale, in Fiorucci M., Zizioli E. (ed.). *La formazione degli insegnanti: problemi, prospettive e proposte per una scuola di qualità e aperta a tutti e tutte*. Lecce: Pensa multimedia, pp. 600 – 604.

Patera, S. (2022). *Povertà educativa. Bisogni educativi interdetti e forme di esclusione*. Milano: Franco Angeli.

Patera, S. (2023). Pobreza educacional de jovens e pobreza educacional de adultos: uma trilha de reflexão por meio de uma atividade de pesquisa e ação com estudantes universitários (pp. 298-310) in: J.M. de Abreu, P.R. Padilha (eds..), *Projeto extensão universitária em movimiento.Artigos produzidos durante as formações do Instituto* Paulo Freire, São Paulo: Instituto de Educação e Direitos Humanos Paulo Freire.

Patera, S., Murri, S. & Scotta, D. (2023). Behind digital educational poverty: third level of the digital divide as a cultural divide between students and teachers – theoretical reflections and empirical evidences from an Italian case study (6322-6328). *Proceedings of 18th International Technology, Education and Development Conference (INTED)*. Valencia: IATED.

Pattaro, C., Riva, C. & Tosolini, C. (2017). *Sguardi digitali. Studenti, docenti e nuovi media*. Milano: FrancoAngeli.

Pellerey, M. (2004). *Le competenze individuali e il portfolio*. Roma: La Nuova Italia.
Picard, R.W. (1995). *Affective Computing,* M.I.T Media Laboratory Perceptual Computing Section Technical Report No. 32, Cambridge (MA).

Robinson, J.P., DiMaggio, P. & Hargittai, E. (2003). New social survey perspectives on the digital divide, *IT&SOCIETY,* 1(5), 1-22. http://uazuay.edu.ec

Sala, A., Punie, Y., Garkov, V. & Cabrera, M. (2020). LifeComp: The European framework for personal, social and learning to learn key competence (No. JRC120911). *Joint Research Centre*

Save the Children, (2021), *Riscriviamo il futuro. Una rilevazione sulla povertà educativa digitale*. https://s3.savethechildren.it/public/files/uploads/pubblicazioni/riscriviamo-il-futuro-una-rilevazione-sulla-poverta-educativa-digitale_0.pdf .

Schwab, K. (2018). *The global competitiveness report 2018*. World Economic Forum.
Simondon, G. (1958). *Du mode d'existence des objects techniques,* Paris: Aubier-Montaigne.

Skov, A. (2016). *What is digital competence*, Centre for Digital Dannelse, https://digital-competence.eu/dc/en/front/what-is-digital-competence/.

Stringher, C., & Patera, S. (2022), Learning to learn: for a reflection on soft skills in a sociocultural pedagogical perspective. *QTimes*, Anno XIV - n. 2, 192-207.

Timmis, S., Broadfoot, P., Sutherland, R. & Oldfield, A. (2016). Rethinking assessment in a digital age: Opportunities, challenges and risks. *British Educational Research Journal*, *42*(3): 454-476. Doi: 10.1002/berj.3215.

Van Deursen, A.J.A.M., & Helsper, E.J. (2015). The Third-Level Digital Divide: Who Benefits Most from Being Online? *Communication and Information Technologies Annual* (10), 29-52. https://doi.org/10.1108/S2050-206020150000010002.

Van Dijk, A.G.M. (2015). *The Deepening Divide*, Thousand Oaks: Sage.

Varela, F.J., Thompson, E. & Rosch, E. (1992). *The Embodied Mind. Cognitive Science and Human Experience*, Cambridge: M.I.T. Press.

von Foerster, H. (1981). *Objects: Token far (Eigen)-Behaviors,* in: *Observing Systems,* Seaside: Intersystems, pp. 274-285.

Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens - With new examples of knowledge, skills and attitude*s. Luxembourg: Publications Office of the European Union.

Žižek, S. (2013). *Leggere Lacan. Guida perversa al vivere contemporaneo*. Torino: Bollati Boringhieri.

Zuboff, S. (2019). Surveillance capitalism and the challenge of collective action. In *New labor forum* (Vol. 28, No. 1, pp. 10-29). Sage CA: Los Angeles: Sage.