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ARTICLE

Learning, Rural Areas and GenAI Tools

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ABSTRACT

Artificial intelligence, AI, specifically the 'intelligent' chatbots exemplified by chapGPT accessing the raw power of Large Language Models, the underlying GenAI technology, such as OpenAI, offers a variety of ways to support teachers. This raw power can however be problematic. Large Language Models can 'hallucinate', providing plausible but fictitious information, furthermore, they require considerable skill in drafting queries that give the precise answer required, the so-called engineering of 'prompts', and lastly, they could provide responses that are dangerous, hurtful or harmful. These are all consequences of the underlying technology, which indiscriminately harvests and recycles the world's digital resources, good or bad, right or wrong, nice or nasty. The educational use of GenAI in rural areas offers possibilities and poses problems, some of which are already implicit in existing rural digital educational provision, objective factors like sparsity, infrastructure and distance, and to cultural factors like the dominance of urban mindsets and understandings. Others are a direct consequence of the nature of GenAI itself. Tools that manage this power and deliver convenient and safe services to educational users can mitigate or eliminate these problems. Teachermatic is one such tool and is critiqued in terms of its rural educational relevance. This introductory and exploratory paper outlines the underlying technical, pedagogic, cultural and ethical challenges of educational AI in rural contexts and reports briefly on trials and workshops with teachers. There is no quick fix or easy answer. The problems of education in rural areas are not obviously or simply ones that GenAI can fix, in fact without supportive policy and resources to focus the direction and deployment of GenAI, it might merely reinforce existing barriers and inequalities.

Keywords: Large Language Models; Rural Areas; Chatbots; Artificial Intelligence; Skills

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1. Introduction

The topic of educational AI in rural areas, for example, the rural areas of Spain, is relatively new and unusual, and is evolving rapidly. Any attempt to document or analyse it must be provisional. Consequently, the method or design here is to set out the factors and the trends, within Spain if possible or rural Europe, and to look where AI and rurality may converge, where there might be problems or possibilities, or where it might be appropriate to make suggestions and recommendations. The intended readership is educationalists with an interest in or responsibility for rural areas. The paper covers a very wide range of topics, and so the references allow readers to move to more substantial accounts and arguments.

The explosive trajectory of artificial intelligence, AI, over the last three years, has been widely documented, explained and reported, and frequently misunderstood [1,2]. Different implementations and ideas for AI have existed since the dawn of computing, at least back in the 1950s. The ambition was always to emulate human intelligence, but progress was always slow and erratic, and the promise oversold and premature [3–5]. The current incarnation of AI is Generative AI, [6], otherwise GenAI, and this is now apparently delivering on that ambition [7].

GenAI works as a much more powerful version of autocomplete, found in computers and mobile phones, and uses the world's digital resources to respond with far more than a simple sentence based merely on personal history and behaviour. It does this using what are called Large Language Models, LLMs, that are 'trained' on all or any of the world's digital resources as the basis for their responses. Alongside these are the simple conversational interfaces, the chatbots, already a familiar feature of websites for institutions and organisations, deflecting user interaction away from human personnel and instead to systems answering a narrow range of queries [8]. The most obvious of these AI bots, emerging in autumn 2022, is chapGPT, interfacing onto OpenAI's LLM. This simple relationship, human, chatbot and LLM, is sometimes mediated by a variety of other systems, Azure, for example, that attempt to constrain the massive but sometimes wayward raw power of the LLM [9]. We must ask,

- Is GenAI merely the latest incarnation of digital technologies, only bigger, faster, more powerful, more intrusive and more pervasive? Or, do these factors mean that GenAI is qualitatively different from earlier digital technologies, a step change rather than just a very steep curve?
- Does GenAI amplify existing digital disadvantages and disenfranchisement? Does it create new forms of disadvantage and disenfranchisement? Does it offer improvements and advantages?
- Can legislation, training, research and publication keep up with
    - the rapidity of the uptake of GenAI?
    - the ever-increasing power, functionality and ease of use of GenAI?
    - the spread and adoption in many tasks and activities?
    - the wider impact of GenAI on healthcare, primary, secondary and tertiary industries, economies, politics, journalism, entertainment and other fields of human activity?
    - the need for education systems to enable their students to flourish lifelong in this changed world?
- In the current context, how do these three sets of questions impact of education in rural areas?

2. The General Problems for Education

There are, unsurprisingly, a range of specific problems with such powerful technologies [10].

2.1. Hallucinations

GenAI specialises in responses that seem stylistically plausible, not necessarily ones that are objectively true. This is unhelpful if not actually dangerous in education and elsewhere [11]. A second-order problem is that the hallucinations themselves become part of the digital data upon which GenAI subsequently feeds; the hallucinations of this iteration form the basis for increased hallucinations of the subsequent iterations [12].

2.2. Harm

LLMs do nothing original; LLMs merely harvest the world's digital resources, attempting to provide plausible

responses. The world's digital resources sadly mirror the world's prejudices, misunderstandings, misinformation and much of its hate, spite and nastiness. The world's digital resources echo the world's sexism and misogyny; its racism, coloniality, nationalism and xenophobia; its neuronormativity, ableism and homophobia, prejudices about rural people and communities, and much else[13]. In short, LLMs have the potential to harm, injure and mislead just as much as to inform, uplift and enlighten.

2.3. Prompting

Users of GenAI quickly learnt that getting the required response from LLMs required very careful crafting of the query, the 'prompt'. This led to the development of the skill, practice and theorising of 'prompt engineering'[14], rapidly supported by courses, experts and tools. In theory, with sufficient expertise and experience, good prompting should avoid misinformation, harm and hallucinations, but rural educators need not only easy access to LLMs but also safe access, and are not likely to have the resources or priorities to gain this experience and expertise[15].

3. Educational Access, Equity and Inclusion

In relation to rural areas specifically, firstly, most education systems are modelled on urban/centralised education systems and not only are these often culturally insensitive and inappropriate to rural areas, for example in Spain[16], they, like any other large systems, are unwieldy, unresponsive and essentially conservative, meaning their corporate response to the growth of GenAI might be risk-averse, unimaginative and managerial, whilst individual usage may proliferate un-moderated, un-regulated and un-managed and thus unsafe. Furthermore, GenAI represents the languages, values, conceptions and priorities of extremely large and powerful global digital corporations[17].

Secondly, most people, certainly most adults and especially those in rural areas, are not in those education systems but may nevertheless be engaged in all sorts of informal digital learning, now powered by pervasive AI in, for example, search engines and content production[18]. So, whilst safer managed forms of educational AI might slowly become available to teachers and learners within education systems, those outside education systems will only have access to the raw and unmanaged forms of educational GenAI.

Alongside the sluggishness of regulatory and legislative processes, the protracted timescales of peer-reviewed research publishing, accounting in part for the proliferation of un-reviewed preprints and newer journals focused on a quick turnaround for an 'Author Processing Charge'[19], further increasingly the delays in accessing reliable analysis and information, whilst opinions and anecdotes, both apocalyptic and evangelical, proliferate in journalism, social media and blogs.

There is a more general problem: access to IT systems depends on infrastructure, connectivity, electricity and finance, which militates against some demographics, including rural areas[20]. GenAI might amplify existing digital, educational, economic, and social inequalities[21]. Redressing the rural infrastructure, connectivity and capacity deficits will, however, add to the environmental and ecological damage already caused by GenAI[22] and may differentially impact rural areas hosting wind farms[23] or solar farms[24]. Every ChatGPT query is up to ten times more energy expensive than a pre-AI search engine query, estimates differ[25], and adds to concerns about complicity in reinvigorated digital neo-colonialism[26,27], especially amongst knowledge workers in the Global South employed to 'train' LLMs[28].

This rather pessimistic reaction to the potential of educational GenAI is representative of the more critical scholars and commentators from academia, politics and the media in the face of considerable global and government optimism and momentum[29]. There are several responses to these problems, namely critical AI literacy to understand the problems, regulation and guidance to control them and dedicated tools to prevent them.

4. Critical AI Literacy

Digital literacy was the phrase given to those skills, confidences, understandings and competencies, necessary for individuals and sometimes communities to survive and, hopefully, to prosper and flourish in societies or organisations where digital technology had become pervasive and ubiquitous. There were, however, several relevant criticisms of the majority of digital literacy standards, courses and curricula

- They were implicitly global, Northern and urban, in

their worldview and mindset.

- They were about compliance, efficiency and conformity.
- They were about retail consumption and servicing the corporate or company labour market.
- They were the earlier IT skills curricula recycled.

Not all but mostly[30]. Critics would say that their apparent objective was not to produce active, engaged and critical citizens (or parents, voters, volunteers, artists or activists) nor to relate to the needs, affordances and aspirations of different and diverse communities outside the urban mainstream[31]. The overriding omission was criticality, the need for scepticism, scrutiny and reflection, asking of questions like

- Who's doing this? Why are they doing it? Who controls it?
- Who wins, who loses? Me, my family, my offspring, my community, the marginal, the environment, wildlife?
- What do I need to know? Where will this end up?
- How much choice have I got? What are the alternatives? Can I change my mind? Can I push back?[32]

AI literacy is now being promoted along the same lines and potentially with the same flaws[33]. Any AI literacy needs to embrace criticality alongside skills, understandings, competencies and confidence, especially as the power of AI rests firmly with a handful of global digital corporations[34], their owners, shareholders and political affiliates, whose resources could overwhelm the economies of smaller nations and rural areas, and can overtake the regulatory systems of supranational organisations. Early work, including work in Spain, does suggest that age-appropriate AI literacy could be introduced across schools[35,36].

5. Guidance and Regulation

Supranational organisations, for example, UK DfE, UNESCO, OECD, EU, and national governments, ministries and agencies have been enthusiastically issuing guidance and drafting regulations for the last two years, though none specifically to rural areas[37]. They do variously suffer from common flaws,

- Guidance on issues of computer security and data management that is generic to computer systems, information systems or data processing systems, for example, GDPR, already regulated and already hopefully observed;
- Specific but random examples and recommendations not clearly, unambiguously, systematically, comprehensively, explicitly or rigorously derived from general (ethical) principles;
- Not recognising that different cultures and communities, for example, rural communities, may have their (ethical) principles, perhaps more conservative or tacit ones than urban or metropolitan ones;
- Focus on education systems, with teachers, parents and schools rather than on education in general;
- Little focus on learning, in whatever appropriate cultural context, that might be casual, informal, unsupported or opportunistic;
- Confusing ethical, meaning perhaps cultural, issues with legal and regulatory ones[37].

The Avallain Lab team[38] has developed an ethical framework specifically for educational GenAI, addressing these flaws. This top-down approach complements a bottom-up approach that tests and evaluates dedicated tools such as Teachermatic (see later).

6. Reflections on Pedagogy

GenAI with its capacity to find and manipulate content, and particularly text, may reinforce pedagogies that focus on the production and consumption of content, that focus on didactic or transmissive pedagogies, and the primacy of the teacher[39]. We argue that pedagogy should have an ethical basis, meaning different pedagogies should be judged on whether they might be harmful or harmless, malign or benign, in their treatment of learners. So, in the case of didactic or transmissive pedagogies, delivered, for example, as large-scale lectures and standardised exams, learners are required to absorb and repeat the curriculum. The focus is on teachers and ignores learners, their individuality, their differences, their history and their cultures, and thus disrespects and disempowers them. There are alternative pedagogies to didactic and transmissive pedagogies, such as

- Constructivism[40], the notion that learners 'construct' learning through their own experiences and interactions, emphasising the complexity of their individuality and prior knowledge,
- Social constructivism[40] the notion that learning is so-

cially situated, and knowledge is constructed through learners interacting with other learners, who can help each other,

- Connectivism[41], a perspective for a distinctly digital age, emphasised that digital learners and digital resources are a vast network, where finding knowledge replaces remembering it
- Generativism[42], a perspective for a distinctly AI age, still only an emerging perspective, emphasizing the more active role that digital technology can play with learners.

These are widely understood and documented, though there is often a difference between the pedagogy espoused and the pedagogy enacted, with much didactic and transmissive pedagogy still in evidence[43]. Implicit in each are the changing relationships between teacher and learner and increasingly digital technologies, that will play out differently in rural cultures, rural demographics and rural infrastructure.

To be systematic and comprehensive, all these different pedagogies should be measured against principles such as,

- Respect for autonomy;
- Justice;
- Beneficence;
- Non-maleficence[44].

whilst recognising how these principles are understood in different cultures and contexts, for example, rural ones. From an ethical and humanist standpoint, we should also consider how educational GenAI performs in supporting concepts such as care, curiosity, criticality, creativity and other humanistic values, and how it aligns with existing practices in rural schools and colleges[45].

The capacity of GenAI to find and manipulate content, particularly text, may reinforce the pedagogic *status quo*, making pedagogy unchanged but more efficient, ignoring its transformative possibilities. It may also deskill teachers if they become over-reliant on it, or alternatively expose them to the risk of redundancy[46]. In rural areas, this would be especially problematic since GenAI can help teachers cover the breadth of the curriculum in small, marginal schools. Avallain Lab is exploring how to gradually introduce these elements into Avallain technologies, including the Teachermatic toolset.

There is also the possibility that educational AI can work directly with learners. Many learners, the more technologically, economically and educationally privileged, are already using AI both directly and indirectly. Educational AI systems are still not flexible enough and safe enough for this. Plagiarism is already the downside of this possibility[47]; Turnitin and other plagiarism detection systems have previously worked by checking each individual student assignment against every other assignment ever submitted globally and identifying similarities. Assignments now generated by AI — as opposed to cut-and-paste — outwit this technology because they are 'original', never previously written or submitted, generated as plausible facsimiles[48]. Summarisers have already been used in this way[49], and AI assistants are pervasive in word processors, search engines and user interfaces. Plagiarism is, however, a distraction (like the calculator or Wikipedia, for example), merely diverting attention away from the fact that curricula, qualifications and syllabi need to respond to the changed worlds of these technologies. GenAI does, furthermore, problematise the notions of originality and creativity, and presents new challenges in the ways that the ownership of IP, intellectual property, needs to be understood and regulated.

Education systems must stop servicing worlds and economies that no longer exist, and rural education systems must adapt to the worlds that do exist[50]. The guidance, mentioned earlier, from bodies like the EU, with its emphasis on school systems, is doubly problematic, in ignoring the need for lifelong learning, to which many of these alternative pedagogies, such as constructivism, would be ideally suited, especially as GenAI will be a factor in the ever more rapid economic and technical changes impacting societies.

7. Rural in Particular

Earlier remarks about the impact of GenAI on industries and economies were general. There are, however, distinct differences in rural areas compared to the mainstream of national economies and their labour markets, social mobility and educational provision. In rural areas

- Depopulation from a variety of overlapping causes is endemic in many rural areas, for example, Spain[51–53], usually alongside threats to the economic and cultural sustainability, viability and stability of communities and households
- Agriculture is a major employer but sharply divides

those who inherit and own farms, those who are tenant farmers, with precarious livelihoods and homes, and those who merely work on them, and divides into large-scale industrialised farms and smaller family farms, often forced to diversify or depend on subsidies [54,55]; there might also be a middle layer of professional farm managers especially on large-scale industrialised farms.

- Tourism is usually the next largest employer [56,57], meaning jobs in hospitality, catering, outdoor pursuits, accommodation, and other service industries, leading to generally low-grade, precarious or seasonal work, though in different countries the balance of tourism between the coastal rural and the inland rural plays out differently [58].
    - Both these two sectors of the rural labour market can often be poorly paid, thereby reducing the local tax base for local services.
- In specific cases, industries or organisations that need to be sited away from populated urban areas, such as military or nuclear [59], are sited in less populated rural areas and their imported specialist staff have some trickle-down benefit to the local community, but sometimes only temporary.
- Some knowledge workers, such as journalists, artists, creatives, media, researchers, and academics [60,61], for example, move from urban to rural areas, exploiting digital infrastructure, a benign lifestyle and lower house prices, but altering the rural demographic and culture. Others live in villages and hamlets and commute to work in towns or cities, depending on the road and rail networks. These groups may be key demographics in the understanding and exploitation of AI in rural areas but there is often scepticism about the nature of any economic 'trickle-down' from these demographics.
- Some rural areas have a disproportionate number of retirees or refugees or economic migrants [62], creating disproportionate demands on local support, care and medical services, on a potentially already diminished local tax base. Inland rural areas and coastal rural areas may differ in this respect in different countries. The underlying factors may be property prices in different countries, in the differences between urban and metropolitan areas, and inland rural areas and coastal rural ones, and climate and infrastructure.
- Schools are either in local towns, if secondary, necessitating bussing, or in villages, if primary, supplying a limited curriculum, struggle to retain teachers and viewed as barely economically viable; sometimes residential or boarding schools are a common solution to rural sparsity; access to higher education is always problematic, involving moving or commuting long distances to an urban centre; educational attainment is often lower but similar to industrially blighted urban areas [63].
- Young people, especially the more able, affluent or confident, drift to towns for further education and employment, in some cases, sending remittances home to support family members and maintain the family property, and in other cases, returning as they start their own families and flee the (perceived) pressures of urban life including crime, commuting and congestion [64].
- These demographic, social and economic differences may be echoed in linguistic and cultural differences and divisions
- Public services, not just education, but primary and secondary healthcare, public transport, shops and markets, public libraries, leisure facilities such as swimming pools and gymnasia, employment and training services, banking and financial services, and political representation are all less secure, accessible and abundant than those of urban areas [65].
- Low population density means low voter density, and rural areas can be under-represented at any national political level, especially if they are perceived as innately and irredeemably conservative.

The sources cited have been chosen for their rural Spanish or at least rural European focus or for their Spanish authorship; they are however often subsumed into comparative studies alongside the urban, so we argue that rurality is comparatively under-researched.

Once these factors are overlaid, the emerging picture is extremely complex and confused, making general prescriptions, recommendations or observations; there are clearly broad differences compared to urban areas, but enormous differences amongst rural ones. Many of the factors militate against social mobility, both economic and cultural [66]. Crucially, in the current context, does GenAI, especially AI in education, make any difference?

One observation is how divisive most of these factors

seem to be in privileging the already privileged. The phrase, 'the hollowing out of the labour market' describes the impact of digital technologies, for example, robotics and computers and now AI, removing more and more of the middling sorts of employment, eventually leaving only lowly paid labouring at one end of the labour market and the most specialised, highly paid at the other. This is, however, a generalised prognosis about the impact on individuals in general, failing to look at the implications in the context of, for example, rural areas.

It could be argued that rural areas require education that addresses skills shortages more than academic achievement, though this may merely reinforce social immobility and the economic status quo. Skills do, however, represent a particular challenge and a particular opportunity for digital learning and now for AI. Skills are often manual, manipulative, tangible, physical or tactile; they often involve doing something tangible, and for authentic and authentic learning[67–69], they need to be in the relevant setting, not at the keyboard, not in the classroom. The challenge is to explore how GenAI can move beyond text and 'understand' activities and procedures in 'real' settings, specifically rural settings. Advances in robotics, in natural language processing and in image processing will make this possible, but not yet, not sustainably and not at scale, so questions of access, inclusion and equity will always be manifest[70].

This is an exploratory paper, outlining what is known about educational GenAI in relation to rural areas. What follows is a brief account of one specific dedicated toolset that shows promise in supporting teachers in rural areas.

8. Toolkits for Teachers

This paper has offered a cautious and critical account of educational GenAI, rather than looking at specific dedicated tools. Teachermatic is one such leading dedicated tool; others include Magic School, Quizizz, Twee, Eduaide, Quiz Gecko and TeachmateAI. Teachermatic pilots and prototypes were funded, first by UfI, then Jisc, the national UK agencies responsible for advice and guidance, and for research, evaluation and development. It now has 70–80% of the UK Further Education market. It exemplifies the dominant approach to supporting teachers in colleges, where its attraction to teachers is reduced workload and reduced stress. The pedagogy is, however, largely didactic. Acceptance and usage based on workload reduction do, however, risk reinforcing existing didactic pedagogies. Whilst it is a convenient and safer alternative to more generic tools like Copilot, which offer fewer safeguards. Work is underway to incrementally diversify pedagogic approaches in ways that would match the needs of different cultures and communities. GenAI support for teachers, of which Teachermatic is an obvious example, must now address,

- More sensitivity to context, culture, country: systems need to be more personalised, able to respond appropriately to the composition, location, background and history of students, to both individuals and groups, and to their teachers and the systems in which they work. This includes the internal learner context and the external learner context[67].
    - Internal learner context means recognition of the individual learner, their community, their achievements, their progress and their aspirations. Currently, most LLM systems are 'stateless', like a calculator; they have no recollection of previous queries and thus of their learners. Connecting the LLM to a learner database can give the LLM access to progressively greater insights into individual learners, part of a more constructivist approach and can link learners together within a group, part of a social constructivist approach.
    - External learner context means the learner's environment, their location, their itinerary and their surroundings and how these might inform and improve learning. Current educational AI has been developed and deployed on computer systems. Deploying onto mobiles with location-awareness, for example, GPS, would open up 'intelligent' contextual mobile learning[69], building on earlier work in rural Spain[68] making learning more situated, personalised and authentic.
- More rural use cases developed: supporting rural teachers deliver specialist or minority subjects, customising course material to rural contexts, and enhancing continued rural teacher professional development
- More pedagogic diversity: these systems grew out of a need to address teacher workload and stress. Subsequent reflection and feedback suggest that this reinforces di-

dactic and transmissive approaches based on content and fails to recognise other approaches, for example, constructivist and social constructivist ones and the formats and techniques used to deliver them.

- More safety: systems depend on responses from the LLM, perhaps OpenAI mediated by Azure, but for Teachermatic also depends on the precise nature of the query and the task set by the teacher. This approach risks, accidentally or deliberately, outcomes which are harmful or hurtful. These risks have now been eliminated.

9. Conclusions

Identifying the contribution of GenAI to rural education is a challenge. The potential and the problems of GenAI have been outlined, firstly in general terms and then in educational terms. The possible responses that would make GenAI safer and useful have been outlined and include critical AI literacy introduced across the curriculum, improved and more specific regulation and guidance and GenAI tools dedicated to supporting education systems. All these, however, have only an indirect impact outside education systems, and this is clearly continuing to be a significant challenge.

Educational GenAI comes with several risks, outlined earlier, for example, the risk of deskilling, for example, in grading[71] and lesson planning[72], or in replacing teachers[73], of reinforcing conservative or inflexible didactic and transmissive pedagogies, of propagating or reinforcing prejudice, harm, and misinformation. Dedicated educational GenAI toolsets, such as Teachermatic, can manage and minimise these and will continue to improve in these respects. These toolsets reduce teacher working hours and stress, but these reductions must now be exploited to diversify and enrich pedagogic approaches and tackle the educational challenges of rural areas, for example, supporting specialist subjects, out-of-school learning and learners with special educational needs.

The general characteristics of rural areas were outlined, though a precise definition of 'rural' was avoided to maintain a high-level perspective, as were their educational dimensions, teacher capacity or bandwidth to take two examples. What is now needed are more specific and concrete analyses from these general characteristics to ways in which educational GenAI tools can be developed, deployed and evaluated for individual rural areas. This is the start of a long process involving many stakeholders, including teachers, parents, community leaders, advisors, developers, trainers, managers and policy makers. The current paper outlines in very general terms the various factors at work, but more specific recommendations would be premature.

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Data Availability Statement

The data used in this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author leads research for Avallain AG, the owner of the Teachermatic technology, which is used as an illustration of current progress, problems, challenges, and opportunities. The authors declare no conflict of interest.

References

[1] Buchanan, B.G., 2005. A (very) brief history of artificial intelligence. AI Magazine. 26(4), 53–60.

[2] Cordeschi, R., 2007. AI Turns Fifty: Revisiting Its Origins. Applied Artificial Intelligence. 21(4–5), 259–279. DOI: https://doi.org/10.1080/08839510701252304

[3] Toosi, A., Bottino, A.G., Saboury, B., et al., 2021. A brief history of AI: how to prevent another winter (a critical review). PET Clinics. 16(4), 449–469.

[4] Haenlein, M., Kaplan, A., 2019. A brief history of artificial intelligence: On the past, present, and future of artificial intelligence. California Management Review. 61(4), 5–14. DOI: https://doi.org/10.1177/0008125619864925

[5] Groumpos, P.P., 2023. A critical historic overview of

artificial intelligence: issues, challenges, opportunities, and threats. In Artificial Intelligence and Applications.1(4), 1181–1197.

[6] Sengar, S.S., Hasan, A.B., Kumar, S., et al., 2024. Generative artificial intelligence: a systematic review. California Management Review, 84, 23661–23700. DOI: https://doi.org/10.1007/s11042-024-20016-1

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

[8] Dam, S.K., Hong, C.S., Qiao, Y., et al., 2024. A complete survey on LLM-based AI chatbots. arXiv:2406.16937. DOI: https://doi.org/10.48550/arXiv.2406.16937

[9] Andersson, H., 2024. Retrieval-Augmented Generation With Azure OpenAI [Bachelor's Thesis]. Mälardalen University: Västerås, Sweden. Available from: https://urn.kb.se/resolve?urn=urn:nbn:se:mdh:diva-67686 (cited 1 April 2025).

[10] Ayyamperumal, S.G., Ge, L., 2024. Current state of LLM Risks and AI Guardrails. arXiv:2406.12934. DOI: https://doi.org/10.48550/arXiv.2406.12934

[11] Ye, H., Liu, T., Zhang, A., et al., 2023. Cognitive mirage: A review of hallucinations in large language models. arXiv:2309.06794. DOI: https://doi.org/10.48550/arXiv.2309.06794

[12] Zhang, M., Press, O., Merrill, W., et al., 2023. How language model hallucinations can snowball. arXiv:2305.13534. DOI: https://doi.org/10.48550/arXiv.2305.13534

[13] Gabriel, I., 2020. Artificial intelligence, values, and alignment. Minds and Machines. 30(3), 411–437.

[14] Bozkurt, A., Sharma, R.C., 2023. Generative AI and prompt engineering: The art of whispering to let the genie out of the algorithmic world. Asian Journal of Distance Education. 18(2), i–vii.

[15] Cain, W., 2024. Prompting Change: Exploring Prompt Engineering in Large Language Model AI and Its Potential to Transform Education. TechTrends. 68, 47–57. DOI: https://doi.org/10.1007/s11528-023-00896-0

[16] Morales Romo, N., 2016. Rural Schools in Spain. Past, present and future: a sociological framework. Available from: https://gredos.usal.es/bitstream/handle/10366/128103/Ruralschools.pdf;jsessionid=610E0BAFE7D21D74EEFA0AB62D56A978?sequence=1 (cited 1 April 2025).

[17] Sorensen, T., Moore, J., Fisher, J., et al., 2024. A roadmap to pluralistic alignment. arXiv:2402.05070. DOI: https://doi.org/10.48550/arXiv.2402.05070

[18] Marquis, Y.A., Oladoyinbo, T.O., Olabanji, S.O., et al., 2024. Proliferation of AI tools: A multifaceted evaluation of user perceptions and emerging trends. Asian Journal of Advanced Research and Reports. 18(1), 30–35.

[19] Ponte, D., Mierzejewska, B.I., Klein, S., 2017. The transformation of the academic publishing market: multiple perspectives on innovation. Electronic Markets. 27, 97–100.

[20] Gillwald, A., 2017. Chapter Two: Beyond Access: Addressing Digital Inequality in Africa. In: The Shifting Geopolitics of Internet Access: From Broadband and Net Neutrality to Zero-Rating. Centre for International Governance Innovation: Waterloo, ON, Canada. pp. 37–54. Available from: https://www.jstor.org/stable/resrep05240.7?seq=18 (cited 1 April 2025).

[21] Lutz, C., 2019. Digital Inequalities in the Age of Artificial Intelligence and Big Data. Human Behavior and Emerging Technologies. 1(2), 141–148. DOI: https://doi.org/10.1002/hbe2.140

[22] Berthelot, A., Caron, E., Jay, M., et al., 2025. Understanding the environmental impact of generative AI services. Communications of the ACM. Special Issue on Sustainability and Computing. 68(7), 46–53. Available from: https://hal.science/hal-04920612v1/document (cited 1 April 2025).

[23] Duarte, R., García-Riazuelo, Á., Sáez, L.A., et al., 2022. Analysing citizens' perceptions of renewable energies in rural areas: A case study on wind farms in Spain. Energy Reports. 8, 12822–12831.

[24] Mérida-Rodríguez, M., Reyes-Corredera, S., Pardo-García, S., et al., 2015. Solar Photovoltaic Power in Spain: Expansion Factors and Emerging Landscapes. In: Renewable Energies and European Landscapes: Lessons from Southern European Cases. Springer: Dordrecht, Netherlands. pp. 63–80. DOI: https://doi.org/10.1007/978-94-017-9843-3_4

[25] You, J., 2025. How much energy does ChatGPT use? Gradient Updates. Available from: https://epoch.ai/gradient-updates/how-much-energy-does-chatgpt-use (cited 1 April 2025).

[26] Kwet, M., 2019. Digital colonialism: US empire and the new imperialism in the Global South. Race & Class. 60(4), 3–26.

[27] Salami, A.O., 2024. Artificial intelligence, digital colonialism, and the implications for Africa's future development. Data & Policy. 6, e67. Available from: https://www.cambridge.org/core/services/aop-cambridge-core/content/view/4BD73E9129A9CD9E9301C61CB2401450/S2632324924000750a.pdf/artificial_intelligence_digital_colonialism_and_the_implications_for_africas_future_development.pdf (cited 1 April 2025).

[28] Rowe, N., 2023. 'It's destroyed me completely': Kenyan moderators decry toll of training of AI models. Available from: https://www.theguardian.com/technology/2023/aug/02/ai-chatbot-training-human-toll-content-moderator-meta-openai (cited 1 April 2025).

[29] Beetham, H.A., 2025. Marking the Government's homework on public sector AI. Available from: https:

//helenbeetham.substack.com/p/marking-the-governments-homework (cited 1 April 2025).

[30] Martin, A., 2006. A European framework for digital literacy. Nordic Journal of Digital Literacy. 1(2), 151–161.

[31] Sun, M., Liu, J., Lu, J., 2024. Digital Literacy in Africa: Exploring its Relationship with Infrastructure, Policy, and Social Inequality. African Journalism Studies. 44(3), 204–225. DOI: https://doi.org/10.1080/23743670.2024.2329705

[32] Hinrichsen, J., Coombs, A., 2014. The five resources of critical digital literacy: a framework for curriculum integration. Research in Learning Technology. 21, 21334. DOI: https://doi.org/10.3402/rlt.v21.21334

[33] 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, Honolulu, HI, USA, 25–30 April 2020; pp. 1–16. DOI: https://doi.org/10.1145/3313831.3376727

[34] Luitse, D., Denkena, W., 2021. The great transformer: Examining the role of large language models in the political economy of AI. Big Data & Society. 8(2). DOI: https://doi.org/10.1177/20539517211047734

[35] Su, J., Ng, D.T.K., Chu, S.K.W., 2023. Artificial intelligence (AI) literacy in early childhood education: The challenges and opportunities. Computers and Education: Artificial Intelligence. 4, 100124. DOI: https://doi.org/10.1016/j.caeai.2023.100124

[36] Casal-Otero, L., Catala, A., Fernández-Morante, C., et al., 2023. AI literacy in K-12: a systematic literature review. International Journal of STEM Education. 10(1), 29.

[37] European Commission, 2022. Ethical guidelines on the use of artificial intelligence (AI) and data in teaching and learning for educators. Available from: https://education.ec.europa.eu/news/ethical-guidelines-on-the-use-of-artificial-intelligence-and-data-in-teaching-and-learning-for-educators (cited 1 April 2025).

[38] Avallain, 2025. About Avallain. Available from: https://www.avallain.com/company/about (cited 1 April 2025).

[39] Redondo-Duarte, S., Ruiz-Lázaro, J., Martínez Requejo, S., et al., 2024. Didactic Strategies for the Use of AI in the Classroom in Higher Education. In: Arinushkina, A. (Ed.). Integration Strategies of Generative AI in Higher Education. IGI Global Scientific Publishing: Hershey, PA, USA. pp. 23–50. DOI: https://hdl.handle.net/20.500.14352/115082

[40] Ertmer, P.A., Newby, T.J., 2013. Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. Performance Improvement Quarterly. 26(2), 43–71.

[41] Mattar, J., 2018. Constructivism and connectivism in education technology: Active, situated, authentic, experiential, and anchored learning. RIED-Revista Iberoamericana de Educación a Distancia. 21(2), 201–217.

[42] Pratschke, B.M., 2024. Generativism. In: Generative AI and Education: Digital Pedagogies, Teaching Innovation and Learning Design. Springer: Cham, Switzerland. pp. 57–72.

[43] Tan, S.C., Voogt, J., Tan, L., 2024. Introduction to digital pedagogy: a proposed framework for design and enactment. Pedagogies: An International Journal. 19(3), 327–336.

[44] Gillon, R., 2003. Four scenarios. Journal of Medical Ethics. 29, 267–268. DOI: https://doi.org/10.1136/jme.29.5.267

[45] Herodotou, C., Sharples, M., Gaved, M., et al., 2019. Innovative pedagogies of the future: An evidence-based selection. Frontiers in Education. 4, 113. DOI: https://doi.org/10.3389/feduc.2019.00113

[46] Hughes, J., 2021. The Deskilling of Teaching and the Case for Intelligent Tutoring Systems. Journal of Ethics and Emerging Technologies. 31(2), 1–16.

[47] Hutson, J., 2024. Rethinking Plagiarism in the Era of Generative AI. Journal of Intelligent Communication. 4(1), 20–31.

[48] Sharples, M., 2022. Automated essay writing: An AIED opinion. International Journal of Artificial Intelligence in Education. 32(4), 1119–1126.

[49] Jones, K.S., 2007. Automatic summarising: The state of the art. Information Processing & Management. 43(6), 1449–1481.

[50] Green, C., Mynhier, L., Banfill, J., 2020. Preparing education for the crises of tomorrow: A framework for adaptability. International Review of Education. 66, 857–879. DOI: https://doi.org/10.1007/s11159-020-09878-3

[51] Pinilla, V., Ayuda, M.I., Sáez, L.A., 2008. Rural depopulation and the migration turnaround in Mediterranean Western Europe: a case study of Aragon. Journal of Rural and Community Development. 3(1). Available from: https://journals.brandonu.ca/jrcd/article/view/91/33 (cited 1 April 2025).

[52] Viñas, C.D., 2019. Depopulation processes in European rural areas: A case study of Cantabria (Spain). European Countryside. 11(3), 341–369.

[53] Czubala Ostapiuk, M.R., Puente Regidor, M., Corullón Hermosa, C.C., 2022. Rural depopulation in Spain: next generation EU as a stimulus to accelerate the transformation. Journal of Liberty and International Affairs. 8(1), 211–228. DOI: https://doi.org/10.47305/JLIA2281211co

[54] Moliner, E.C., Bosque, M.I.A., 2023. Rural migration and agricultural modernization: an analysis of provincial Spain during its great rural exodus, 1960–1981. Historia Agraria: Revista de Agricultura e Historia Rural. (90), 223–255.

[55] Arnalte, E., Ortiz, D., 2003. Some trends of Spanish agriculture. Difficulties to implement a Rural Development model based on the multifunctionality of agriculture. In Proceedings of the Policies, Governance and Innovation for Rural Areas" International Seminar, Arcavacata di Rende, Italy, 21–23 November 2003. Available from: https://www.researchgate.net/profile/Dionisio-Miranda-2/publication/228420409_Some_trends_of_Spanish_agriculture_Difficulties_to_implement_a_Rural_Development_model_based_on_the_multifunctionality_of_agriculture/links/00b7d5368961f6936c000000/Some-trends-of-Spanish-agriculture-Difficulties-to-implement-a-Rural-Development-model-based-on-the-multifunctionality-of-agriculture.pdf (cited 1 April 2025).

[56] Barke, M., 2004. Rural tourism in Spain. International Journal of Tourism Research. 6(3), 137–149.

[57] Trechera Herreros, J.L., Morales Fernández, E., 2012. Rural tourism as an alternative to the development for rural areas and the creation of employment. International Journal of Humanities and Social Science. 2(20), 162–174.

[58] Cuadrado-Ciuraneta, S., Durà-Guimerà, A., Salvati, L., 2017. Not only tourism: Unravelling suburbanization, second-home expansion and "rural" sprawl in Catalonia, Spain. Urban Geography. 38(1), 66–89.

[59] Ando, M., 2013. Estimating the effects of nuclear power facilities on local income levels: A quasi-experimental approach. Department of Economics Working Paper. No. 2013:3. Available from: https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID2365084_code1551782.pdf?abstractid=2365084&mirid=1 (cited 1 April 2025).

[60] Maddah, L.S., Arauzo-Carod, J.M., 2025. Cultural and creative industries and employment growth in urban and rural Catalonia. Regional Studies. 1–21. Available from: https://interaccio.diba.cat/sites/interaccio.diba.cat/files/cultural_and_creative_industries_and_employment_growth_in_urban_and_rural_catalonia.pdf (cited 1 April 2025).

[61] Roberts, E., Townsend, L., 2016. The contribution of the creative economy to the resilience of rural communities: exploring cultural and digital capital. Sociologia Ruralis. 56(2), 197–219.

[62] Egidi, G., Quaranta, G., Salvati, L., 2020. Unraveling causes and consequences of international retirement migration to coastal and rural areas in Mediterranean Europe. Land. 9(11), 410.

[63] Fargas-Malet, M., Bagley, C., 2022. Is small beautiful? A scoping review of 21st-century research on small rural schools in Europe. European Educational Research Journal. 21(5), 822–844.

[64] Callejo-González, J.J., Ruiz-Herrero, J.A., 2024. Factors influencing the decision of young adults to remain in their rural environment: Social origin, education and gender. Journal of Rural Studies. 106, 103206. DOI: https://doi.org/10.1016/j.jrurstud.2024.103206

[65] Ortega-Reig, M., Schürmann, C., Ferrandis Martínez, A., 2023. Measuring access to services of general interest as a diagnostic tool to identify well-being disparities between rural areas in Europe. Land. 12(5), 1049. DOI: https://doi.org/10.3390/land12051049

[66] Černič Istenič, M., 2023. Social Dimension of Rural Areas. Available from: https://zenodo.org/records/7807982/files/SHERPA-Position-Paper-Social%20Dimension%20of%20Rural%20Areas.pdf?download=1 (cited 1 April 2025).

[67] Traxler, J., 2011. Context in a wider context. MedienPädagogik: Zeitschrift für Theorie und Praxis der Medienbildung. 19, 1–16.

[68] Zambrano, J., Ramirez, E., Orrego, T., 2019. Possibilities of mobile learning in rural contexts. In: World Conference on Mobile and Contextual Learning, 110–117. DOI: https://doi.org/10.21125/edulearn.2019.2555

[69] Kukulska-Hulme, A., Sharples, M., 2009. Mobile and contextual learning. Special issue of Association for Learning Technology Journal (ALT-J), Research in Learning Technology. 17(3), 159–160.

[70] Subrahmanyam, G., 2020. UNESCO-UNEVOC Study on the Trends Shaping the Future of TVET Teaching. UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training: Bonn, Germany. pp. 1–40.

[71] Corbin, T., Deranty, J.P., Duke-Yonge, J., et al., 2025. We Need to Talk about GenAI Grading and Tutoring Systems. American Association of Philosophy Teachers Studies in Pedagogy. DOI: https://doi.org/10.5840/aaptstudies2025417101

[72] Gretton, G., Lea, S., 2024. Scheme Planning, Artificial Intelligence and Student Teachers: A Cautionary Tale. Reaching into Research. 3(3), 18–26.

[73] Karakose, T., 2024. Will Artificial Intelligence (AI) make the school principal redundant? A preliminary discussion and future prospects. Educational Process: International Journal (EDUPIJ). 13(2), 7–14.