FORUM PEDAGOGICZNE

2024, 14, 2.1: 255–271
p-ISSN 2083-6325; e-ISSN 2449-7142
DOI http://doi.org/10.21697/fp.2024.2.1.19

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Received: 21.09.2024; revised: 22.10.2024; accepted: 23.10.2024

GENERATIVE ARTIFICIAL INTELLIGENCE: VERIFICATION OF EDUCATIONAL APPLICATIONS MODEL

GENERATYWNA SZTUCZNA INTELIGENCJA – WERYFIKACJA MODELU ZASTOSOWAŃ EDUKACYJNYCH

Streszczenie: Generatywna sztuczna inteligencja (GAI) staje się istotnym narzędziem edukacyjnym, wpływając na sposób projektowania i realizacji działań edukacyjnych. Artykuł przedstawia autorski model zastosowania GAI w edukacji, identyfikując pięć kluczowych ról, jakie może pełnić w kontekście szkolnym. Model ten obejmuje m.in. wspieranie nauczycieli w tworzeniu materiałów dydaktycznych, angażowanie uczniów w zadania z AI oraz ułatwianie zadań administracyjnych. Badanie z udziałem nauczycieli z Polski (N=995) wskazuje, że efektywne wykorzystanie GAI wymaga odpowiednich kompetencji pedagogicznych, w tym umiejętności tworzenia odpowiednich wytycznych dla AI oraz oceny jakości generowanych materiałów. Wnioski wskazują na potrzebę dalszych badań nad długoterminowym wpływem AI w edukacji, szczególnie w kontekście etycznym i społecznym. Celem artykułu jest pokazanie, jak odpowiednio wdrożone GAI może wzbogacić tradycyjne metody nauczania, przyczyniając się do bardziej innowacyjnego i efektywnego środowiska edukacyjnego.

Słowa kluczowe: generatywna sztuczna inteligencja, edukacja, model zastosowania, kompetencje nauczycieli, etyka AI, innowacje pedagogiczne

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Abstract: Generative artificial intelligence (GAI) is emerging as a significant educational tool, reshaping how educational activities are designed and implemented. This article presents a novel model for GAI applications in education, identifying five core roles it can assume in school contexts. These roles include supporting teachers in content creation, engaging students in AI-driven tasks, and facilitating administrative duties. A study with Polish teachers (N=995) suggests that effective use of GAI demands appropriate pedagogical skills, such as crafting prompts and evaluating AI-generated content. Findings emphasize the need for further research on the long-term impacts of AI in education, particularly concerning ethical and social dimensions. The article aims to demonstrate how thoughtfully integrated GAI can enhance traditional teaching methods, contributing to a more innovative and effective educational environment.

Keywords: generative artificial intelligence, education, application model, teacher competencies, AI ethics, pedagogical innovations

Introduction

Generative artificial intelligence (GAI) is a technology that has been widely discussed for several years, particularly regarding its impact on various aspects of social life as well as individual human functioning particularly in societies that are highly digitalized (Sabherwal, Grover 2024; Torczyńska 2019). This interest, often accompanied by strong and sometimes extreme emotions, reflects both the enthusiasm and concerns surrounding its integration into social life and almost all professional fields, including education (Fatyga 20024; Maziarz 2024; Onesi-Ozigagun et al. 2024; Plichta 2024).

The technology we discuss possess the following important characteristics:

1. Machine Learning Capabilities: These AI tools can learn based on diverse types of data (text, visual, audio, numerical), often utilizing large datasets (big data) to enhance their performance (Fazlagić et al. 2022).
2. Task Execution and Content Generation: The assigned tasks usually result in new outputs, such as text, images, numerical data, videos, or audio materials—or combinations of these forms. These tools can also solve specific tasks (e.g., mathematical, logical) and make decisions based on data. The quality of AI-generated outputs can often match, or even surpass, those produced by humans (Fazlagić et al. 2022).
3. Natural Language Interaction: Users can assign tasks to these tools using natural language prompts, the same language used for human communication. This involves a language model, where generative AI is often referred to as collaborative or conversational, reflecting the human-technology interaction in this context. Using natural language is the key factor that enables the widespread adoption of this technology (Baretto et al. 2023; Fazlagić et al. 2022).

In the given context, GAI tools function in ways that resemble human intelligence, which is traditionally associated with activities like learning, creation, and problem-solving, typically attributed to living creatures/humans. Although earlier forms of artificial intelligence could perform to a certain extent the tasks mentioned above, the generative aspect driven by natural language has redefined AI as a distinctly new technology—generative AI.

Impact on Education

It seems obvious that powerful digital technology —easy to use due to its natural language interface—will inevitably bring profound changes to education and all its actors (Pyżalski, Łuczyńska 2024; Strannegård 2023). Public and media discussions on the impact of generative AI in education are very common. They largely focussed on the associated risks, particularly issues of plagiarism and cheating that AI tools might facilitate in educational settings. Current analyses suggest that broader discussions about the role of generative AI in education are often overly simplistic and lack depth (Piotrowski 2024).

Moreover, there is a notable scarcity of empirical studies providing reliable data on whether and how teachers and students use generative AI tools in education, as well as their attitudes and beliefs about such use. Existing research predominantly focuses on higher education (Chen et al.2020), although studies exploring the application of generative AI tools in earlier educational stages are beginning to grow rapidly particularly in Asian countries (Jauhiainen, Guerra 2023; Wu, Yu 2024).

It is also important to highlight that educational systems have little choice in this matter; the integration of generative AI in education is unavoidable. Even without careful consideration and planning of the pedagogical uses of this technology, students and, to some extent, educators will continue to use these tools. However, this kind of "natural" and "spontaneous" adoption comes with considerable risks, such as failing to fully harness the educational benefits of these solutions or, on the other hand, causing more harm than benefit. Moreover, existing research consistently shows that these tools are already a reality in schools, not just a future possibility, with their prevalence rapidly growing (Rizvi, Waite, Sentance 2023)

Model of Using Generative Artificial Intelligence in Education

A key challenge when discussing the use of generative artificial intelligence (AI) tools in education is that these tools encompass a wide range of diverse applications that can impact various stakeholders in the education system, including students, teachers, and education administrators, and to some extent students' parents/carers. To effectively address these applications, it's crucial to categorize and classify them, especially from the perspective of teachers using these tools in educational settings,

often with student involvement. The proposed model, which also provided the theoretical basis for the research in this report, outlines various roles of generative AI used by educators, each with distinct names and purposes (see Fig. 1).

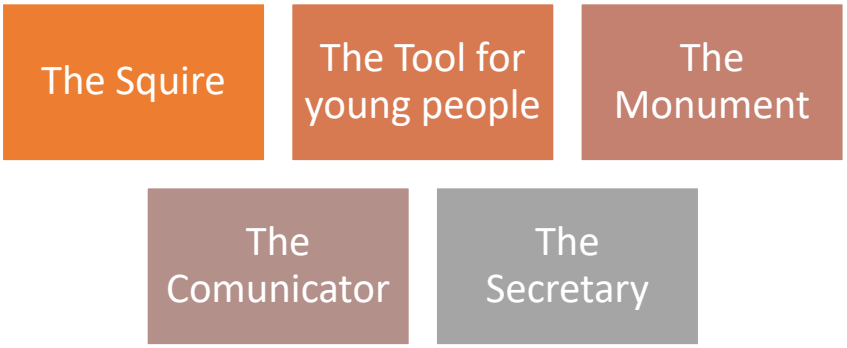

Fig. 1. Roles (Groups of Applications) of Generative AI in Education (teacher perspective)

Below is a detailed examination of these roles, highlighting their differences as well as their importance in the context of education:

The Squire

In this role, the teacher uses generative AI as "a squire" to perform specific tasks assigned by the very teacher. In this context, AI is not directly used by students during lessons, nor do they interact with these tools. Typical applications include:

Developing and customizing educational resources: Teachers use AI to create and modify various materials, such as texts, illustrations, and assignments. This can include tailoring resources for students with special needs or adjusting content for different proficiency levels.

- Assessing student progress: AI tools assist educators in analyzing student performance, identifying areas for improvement, and tracking progress over time.
- Generating lesson ideas and planning: Teachers can leverage AI to brainstorm lesson concepts, structure lesson plans, and organize the curriculum efficiently.
- Translating educational content: AI provides translation services, making educational materials accessible to students who speak different languages or making them available to teachers who do not speak a certain language.
- Editing, simplifying, and summarizing texts: AI helps in refining educational content by simplifying complex texts, editing drafts, or summarizing lengthy materials.

- Creating and reviewing test assignments: AI supports teachers in designing test questions, quizzes, and assessments, as well as reviewing them for accuracy and relevance.

The Tool for young people

In this role teachers integrate generative AI tools into classroom activities, positioning students as the primary users. In these scenarios, educators guide students on using AI for specific tasks or encourage them to explore these technologies independently. For instance, a foreign language teacher might show students how to create an AI avatar for practicing conversations in the target language or generate personalized exercises based on errors found in their written work. This method helps students develop AI-related skills that are valuable not only in educational settings but also in self-directed learning, where they make independent choices about their learning process. A key aspect of this approach is that students, not teachers, are the main users of the AI tools.

The Monument

In this role, generative AI tools become the subject of education. This means that the teacher conducts lessons/activities focusing on AI in the context of its development, societal role, and the associated risks and ethical or legal dilemmas (both positive and negative aspects). From an educational standpoint, this is a crucial aspect that goes beyond the mere technical use of AI tools. Neglecting these issues can lead to problems associated with unreflective, unethical, or reckless use of AI technologies.

The Communicator

Generative AI tools based on language models can effectively create messages directed at various stakeholders in the educational environment, such as students, parents, and colleagues. They can also analyze and respond to messages from others. However, it's essential to consider that just because AI can perform these tasks does not necessarily mean it is always appropriate to use it in this way. In communication, one should reflect on how such "automated" communication might impact the authenticity and quality of human relationships, which are fundamental to effective communication.

The Secretary

Generative AI tools excel in administrative tasks, such as generating reports, compiling summaries, preparing statements, analyzing data, and creating

visualizations. Therefore, both teachers and school administrators can use these tools as their "secretary" to perform or facilitate tasks in this area, enhancing efficiency in handling administrative duties.

This model underscores the diverse roles that generative AI can play in education, tailored to meet different needs and contexts, and emphasizes the importance of teacher competence in effectively harnessing these technologies for educational benefit.

Model of Utilizing Generative Artificial Intelligence in Education

When discussing the incorporation of generative artificial intelligence (AI) tools in education, it is crucial to recognize that these tools have a broad spectrum of applications, each impacting different stakeholders such as students, teachers, and administrators. The diversity of these applications necessitates a structured approach to categorize and typologize them, especially from the perspective of educators who might integrate these tools into their teaching methods. The proposed model, which also serves as the theoretical underpinning for the research in this report, delineates various roles (or applications) of generative AI in education, each with specific names and functions (refer to Figure).

Figure: Roles (Categories of Applications) of Generative AI in Education

Below is a detailed examination of these roles, highlighting their distinct characteristics and their relevance in meeting educational needs:

The Squire Role

In the "Squire" role, the teacher employs generative AI as an assistant to carry out tasks assigned by the educator. In this capacity, AI is used solely by the teacher and not directly accessed by students during lessons. Common uses in this category include:

- Crafting and modifying educational materials, such as texts, illustrations, and assignments. This can involve tailoring content for students with special educational needs or differentiating materials for various proficiency levels.
- Generating lesson planning ideas, including structuring classes or mapping out the curriculum.
- Translating educational content from other languages to ensure accessibility.
- Simplifying, revising, or summarizing complex texts for better comprehension.
- Designing and verifying test questions and assignments.
- And other supportive tasks.

It is important to emphasize that the effectiveness of generative AI in these tasks hinges on three primary factors. First, the teacher must recognize a need for

a specific task, such as adapting materials, and be willing to use AI for assistance. Second, the teacher must possess the necessary skills to provide the AI with effective prompts that yield quality outputs suited to educational goals. Third, the teacher should be capable of critically assessing the AI-generated content to refine or accept it as appropriate. Ultimately, while generative AI can enhance educational processes, its value is maximized in the hands of skilled educators.

Tool for Student Use

In this role, generative AI tools are integrated into classroom activities where students are the main users. Teachers guide students on how to leverage AI for specific assignments or encourage them to experiment with these tools independently. For instance, in language classes, a teacher might show students how to use AI to create a virtual character for conversational practice in the target language, or how to generate exercises tailored to their specific errors in written work. This approach not only builds AI-related skills but also fosters students' autonomous learning capabilities, empowering them to make independent decisions about their learning paths.

The Monument Role

In this capacity, generative AI becomes the focus of instruction itself. Teachers conduct lessons that explore the development, societal impact, and associated risks, ethical issues, and legal considerations of AI technologies. This educational approach is critical because it goes beyond mere technical proficiency with AI tools, fostering a deeper understanding of the broader implications of AI in society. Failing to address these aspects can lead to uncritical, unethical, or even dangerous uses of AI.

The Communicator Role

AI tools, particularly those based on language models, can efficiently generate messages aimed at various stakeholders within the educational ecosystem, including students, parents, and fellow educators. They can also interpret and respond to incoming communications. However, it is essential to consider that the use of AI in communication should be carefully evaluated. Automated communication might affect the authenticity and depth of human interactions, which are pivotal to effective educational relationships and community building.

The Secretary Role

Generative AI excels in handling administrative tasks, such as creating reports, summarizing information, preparing official statements, analyzing data, and developing visual representations. Both teachers and school administrators can benefit from using AI as a "Secretary" to streamline and enhance the efficiency of their administrative workload, freeing up time to focus on more strategic educational responsibilities.

This expanded model emphasizes the versatile roles that generative AI can play within the educational landscape, offering targeted solutions tailored to diverse contexts and needs. It also underscores the critical role of teacher expertise in effectively integrating these technologies to enhance learning outcomes and operational efficiency in education. environment.

Methods

The study included 995 teachers, with a significant majority being women, who accounted for 82% of the participants. Men made up 17% of the respondents, while 1% identified as "other."

The age distribution among the teachers showed that the largest group, 41%, were between 46 and 55 years old. Nearly one-third of the participants, 28%, were aged between 36 and 45 years. About 11% were under the age of 35, and the remaining participants were over 55 years old (18%).

The teachers were selected using stratified random sampling from all provinces of Poland, ensuring proportional representation based on the location of their schools—urban, rural, and mixed urban-rural municipalities. The sample consisted of teachers from grades 4-8 of primary schools across the entire country.

In terms of residence, 34% of the teachers resided in rural areas, 29% in towns with a population between 20,000 and 100,000, and 21% in smaller towns with fewer than 20,000 inhabitants.

Additionally, 25% of the surveyed teachers indicated that they had used generative artificial intelligence at least once in their professional work. The results presented in the article focus specifically on this subgroup of teachers.

The quantitative part of the study was conducted through an online survey in December 2023. In addition, a separate group of 20 teachers who actively use generative artificial intelligence in their work was studied. These teachers were selected using the snowball sampling method and provided detailed accounts of how they utilize these tools in their professional practice, illustrating both the range of uses and the conditions influencing the application of these tools. Based on the literature review and the findings from this qualitative study, a questionnaire was developed, which included a list of various ways of using generative AI in

teaching. Respondents were asked to indicate whether they had never engaged in each activity, had done it once or a few times, or had done it multiple times.

The research was conducted as part of the NASK (Research and Academic Computer Network – National Research Institute) research project titled "Nationwide Quantitative and Qualitative Research on the Educational Use of Generative Artificial Intelligence by Teachers of Grades 4-8 in Primary Schools." (Pyżalski in press)

The objective of this article is to present part of the data from the project, namely quantitative findings on the specific activities undertaken by teachers who actively use generative AI, along with illustrative examples from the qualitative part of the study. The results are the basis to test the model presented in the introductory part of the article.

Results

Firstly, the table 1 presents all five model roles with specific activities listed as well as examples of those activities that have been described in the interviews by teachers (N=20) that actively implemented GAI in their professional activities.

Table 1. The model roles of GAI educational uses with listed activities and examples of them presented by the teachers in the interviews

Role of generative artificial intelligence	Activities	Exemplification from the interview
The Squire	Creating Lesson Plans; N=249 [S]	It also creates tasks from YouTube videos very nicely. I just paste the YouTube link and specify what kind of exercises I want, and not only do I get the transcription, but I can also say, "Now create this type of exercise, that type of exercise, and another one based on the material." For me, the main advantage is the time saved, because while I could create these tasks myself, it would probably take me around 10 hours (4).
	Creating Graphical Teaching Materials; N=248 [S]	I shared my screen, and the kids saw that the drawing could actually be brought to life with artificial intelligence—that it's not just a drawing, right? It can be animated; it can become something cool, transformed.(10)

Role of generative artificial intelligence	Activities	Exemplification from the interview
	Translating Educational Materials; N=248 [S]	Mostly, it's about translations because sometimes Google Translate just doesn't cut it—it's too machine-like, right? Of course, it's evolving, but I've noticed, for example, and I also try to look for opinions on foreign websites, that translations with artificial intelligence are already better because they more closely resemble the target language. For instance, when I translate tasks from Polish, especially in subjects like physics, where I have students who need the material prepared for them. Despite some of them having been here since the start of the war, they still don't fully understand the content, especially in technical subjects (10)
	Creating Tests/Exams; N=249 [S]	Recently, I've been uploading tests and simply asking the chatbot to generate 10 similar ones in that style. The worksheets it created were actually really well-prepared (19)
	Adapting Texts for Students with Special Educational Needs; N=249 {S]	I received, let's say, a ten-sentence task to complete, but I didn't like the sixth task. So, I wrote what I didn't like, and I got a new version of the same task with the suggested changes until I was satisfied with the final result. Of course, I could also ask for an answer key to the prepared task, and I got that as well. These kinds of tasks actually worked—they worked well enough that I even used them later and could test how the kids handled them (1).

Role of generative artificial intelligence	Activities	Exemplification from the interview
	Assessing Student Work; N=249 [S]	For example, they can receive immediate feedback on a topic; they don't have to wait for me to provide it. If they write a program and something isn't working, they can submit it to either Blackbox or ChatGPT and ask, 'Why isn't my program working?' and 98% of the time, they will receive the correct answer immediately. There doesn't have to be a line waiting to ask me this question, they don't need to email me, and I will only handle the 2% that ChatGPT couldn't solve, which means a certain automation of the process that allows me to have more time to deal with more important matters than checking someone's work (9)
	Creating Materials for School Decorations; N=248 [S]	Creating posters (17)
The Communicator	Creating Communications (e.g., Emails to Students); N=250)[C]	Sometimes I find myself not knowing how to write emails to students, so I make a list of what should be in the email and ask the chat to generate it, but it takes about the same amount of time because I still have to read and correct it afterwards. So, I use it for longer forms, but that happens quite rarely (9)
	Correspondence with Parents/ Guardians; N=249 [C]	When I have to write a longer email, especially an unpleasant one, I usually jot down the main points, typically 3 or 4, and then I ask to make it sound more polite and civilized. I end up with a very smooth email, ready to send (3).
The Monument	Conducting Lessons on Risks of Using Generative AI; N=250 [M]	It's not about them blindly believing whatever is written there; we also discuss it afterward (10) [about misinformation risk]

Role of generative artificial intelligence	Activities	Exemplification from the interview
	Conducting Lessons on Opportunities of Using Generative AI; N=250 [M]	I don't think it helped them a lot, but I fulfilled my duty of spreading knowledge. I showed them how it works, how to log in, and explained the differences between version 3.5 and 4, demonstrating how they respond differently to questions. When the next class reaches this stage, I'll show them as well, of course. Probably around the middle of seventh grade, at the beginning of the next semester, I'll dedicate an entire lesson to showing them how it works, right? What they can actually gain from it (2).
	Discussing Risks of Using Generative AI at Parent Meetings; N=250 [M]	Not present in the interview
	Discussing Opportunities of Using Generative AI at Parent Meetings; N=248 [M]	Not present in the interviews
	Conducting Lessons on Unethical Use of Generative AI; N=248 [M]	One of the students took out a phone, and then I started consulting with ChatGPT on what we should do in this situation. ChatGPT responded excellently, suggesting that we refer to the rules and regulations we had established. I also asked ChatGPT whether the student should be punished in some way (12)
	Training Other Teachers on Using Generative AI; N=250 [M]?	Not present in the interviews Some teachers brought up exchanging ideas among staff in the school or in online groups.
The Secretary	Creating School Documentation; N=250 [Sec]	It's also very well-suited for writing reports that no one reads, which we have to do a lot of at school. You get a very polished and specific text that you can send out—it includes all the information I care about, but everything is wrapped up in a very nice suit of politeness (3).

Role of generative artificial intelligence	Activities	Exemplification from the interview
The Tool for Students	Instructing Students on Using Specific Generative AI Tools; N=250 [T]	I had a lesson about Copernicus because it's the Year of Nicolaus Copernicus. The kids were learning who Nicolaus Copernicus is, and they drew their own pictures. Then, with just that one phone, I took a photo, connected to Windows, and shared my screen. The kids saw that their drawing could be brought to life with artificial intelligence—that it's not just a drawing, right? It can be brought to life, it can be something cool, transformed!(10)
	Creating Dialogue Simulations; N=246 [T]	You could talk to Einstein—that is, there was a generated image of Einstein, and you could ask him questions. He would respond, of course, in English (17).
	Assigning Homework Requiring Use of Generative AI; N=250 [T]	Currently, I am doing it alongside the students. For example, we are working on an IT-chemistry project in high school together with the chemistry teacher, where we will use artificial intelligence to improve work quality in the chemistry lab, and the students are thinking about how to do this. We will create such a semester project together with the school chemist (12)
	Creating Artistic Outputs for Use with Students; N=250 [T]	I divided the students into two groups. First, the first group had a leader appointed, who sat in front of the computer, while the rest of the group received a picture that they had to describe. During this time, the leader wrote down what the group described and, using the AI image generation option, created an image based on the description of another picture (17)

Abbreviations in the square brackets refer to the first letters of roles in the model.

It is important to note that the activity table was developed based on literature on the use of generative artificial intelligence (GAI) and specific applications, as well as primarily on qualitative research (interviews). As a result, we observe almost complete alignment of the categories with examples from the interviews. These

examples provide a clearer understanding of the practical nature of specific educational activitie (see Fig. 2.).

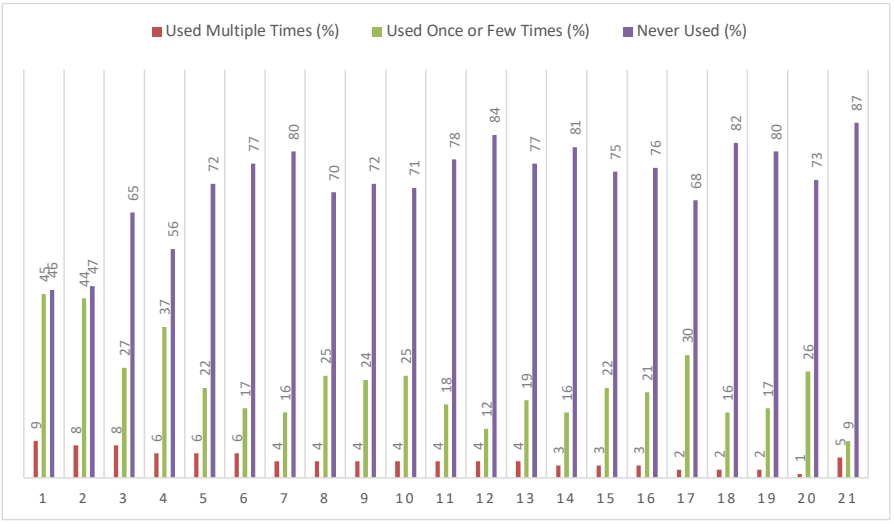

Fig. 2. Quantitative analysis of specific applications of generative artificial intelligence by teachers in their work

Abbreviations in the brackets refer to the first letters of roles in the model

Creating Lesson Plans; N=249 [S]

Creating Graphical Teaching Materials; N=248 [S]

Translating Educational Materials; N=248 [S]

Creating Tests/Exams; N=249 [S]

Adapting Texts for Students with Special Educational Needs; N=249 {S]

Creating Communications (e.g., Emails to Students); N=250)[C]

Correspondence with Parents/Guardians; N=249 [C]

Conducting Lessons on Risks of Using Generative AI; N=250 [M]

Creating School Documentation; N=250 [Sec]

Instructing Students on Using Specific Generative AI Tools; N=250 [T]

Creating Dialogue Simulations; N=246 [T]

Assessing Student Work; N=249 [S]

Conducting Lessons on Opportunities of Using Generative AI; N=250 {M]

Creating Materials for School Decorations; N=248 [S]

Discussing Risks of Using Generative AI at Parent Meetings; N=250 [M]

Discussing Opportunities of Using Generative AI at Parent Meetings; N=248 [M]

Conducting Lessons on Unethical Use of Generative AI; N=248 [M]

Assigning Homework Requiring Use of Generative AI; N=250 [T]

Training Other Teachers on Using Generative AI; N=250 [M]?

Creating Artistic Outputs for Use with Students; N=250 [T]

Other Uses; N=171

The data shown in Fig. 1 generally confirm the validity of the model since all the activities included in the model roles have been conducted by some proportion of the teachers actively using GAI in their work. What stands out is that using GAI in a role of the Squire is more prevalent comparing to other roles, particularly those when students are active.

Discussion

The integration of generative artificial intelligence (AI) in education marks a significant shift in how educational activities are designed and experienced. This study highlights the varied roles AI can play, from automating administrative tasks to enhancing personalized learning. Effective use of these technologies, however, depends on educators' skills, attitudes, and the careful integration of AI tools with pedagogical objectives (Fatyga, 2024; Maziarz, 2024; Onesi-Ozigagun et al., 2024; Plichta, 2024). The study offers a comprehensive model of AI applications in education, identifying distinct roles—ranging from supporting teachers in content creation to enabling students as primary users of AI-driven tasks.

The research confirms a five-role model of AI utilization in education, which appears promising but requires further refinement. Effective use of AI tools demands high teacher competencies, such as recognizing when to delegate specific tasks (e.g., material adaptation) to AI, having the skills to prompt AI effectively, and the ability to assess the quality of AI-generated outputs. Thus, generative AI can add significant value to education but mainly in the hands of knowledgeable educators. Emphasis should be placed on scenarios where students use AI tools, ensuring they also learn about the social and ethical implications of new technologies.

Future research should explore the long-term effects of AI in educational settings, with an emphasis on empirical evidence supporting the model's implementation. Expanding studies to include diverse educational contexts and stakeholder perspectives will provide a more nuanced understanding of AI's potential in enhancing teaching and learning. Ultimately, integrating AI in education should complement rather than replace traditional methods, enriching the learning experience and fostering a more innovative educational environment (Pyżalski, Łuczyńska, 2024).

While this study offers valuable insights into the use of generative AI in education, it has its limitations. A key limitation is the reliance on self-reported data that may be affected by biases such as social desirability or recall inaccuracies. Moreover, focusing on teachers from grades 4-8 of Polish primary schools limits

the generalizability of the findings to other educational levels or contexts. The absence of longitudinal data also restricts understanding of the long-term impacts and sustainability of AI in education. Future research should address these gaps by employing more diverse samples, longitudinal approaches, and expanding the scope to include various educational levels and international settings.

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