Media Literacy in the Era of Synthetic Media and Generative Artificial Intelligence: Perceptions of Primary Education Teachers

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Abstract

The dynamic development of generative artificial intelligence and the emergence of synthetic media are significantly transforming the modern media ecosystem, opening new opportunities, but also posing serious challenges for media and information literacy. The increasingly frequent presence of AI-generated content (text, image, audio, and video) blurs the boundary between authentic and synthetic information, which leads to a rethinking of traditional concepts and the need for new competencies for functioning in the digital society. In this context, critical thinking, AI literacy, and algorithmic literacy become key elements of contemporary media education. The purpose of this paper is to analyze the implications of synthetic media on media and information literacy and the need to redefine educational competencies in conditions of generative artificial intelligence, by examining the perceptions of primary education teachers. The research combines theoretical analysis of relevant literature and empirical research with a survey questionnaire. The focus is on teachers' awareness of synthetic media, their views on the application of generative artificial intelligence in education, and the need to develop new competencies among students and teachers. The results are expected to show that traditional models of media and information literacy are not enough, but that their expansion through the integration of AI literacy, algorithmic literacy, and critical thinking as key competencies of the 21st century is necessary. The research findings can contribute to the advancement of theoretical knowledge in the field of media education, as well as to the creation of modern educational policies and practices aimed at the development of critical, responsible, and media-literate citizens.

Keywords: synthetic media; generative artificial intelligence; AI literacy; algorithmic literacy; critical thinking

1. Introduction

The digital transformation of society has significantly changed the way information is created, processed, distributed, and used. The development of digital platforms, social media, and algorithmic systems has enabled rapid access to vast amounts of information and knowledge, while simultaneously creating a need to develop the skills to critically understand, analyze, and evaluate them. In this context, media and information literacy has emerged as a crucial competency for active, critical, and responsible participation in the modern information society. Its significance is particularly pronounced in education, where teachers play a key role in developing students' ability to approach information and media content critically.

The development of generative artificial intelligence marks a new turning point in the media and information ecosystem. Generative systems enable the creation of text, image, audio, and video content, with their realism and accessibility constantly increasing. As a result, the line between authentic and synthetically created or altered content is becoming increasingly difficult to distinguish. This process opens up new opportunities for learning, communication, and creative expression, but at the same time creates serious challenges related to disinformation, manipulation, content authenticity, privacy, and the ethical use of technology.

In this context, synthetic media—that is, media content created or significantly altered using algorithms and artificial intelligence technologies—take on particular significance. They encompass various forms of textual, visual, audio, and video content, including deepfake materials and synthetic voices. Although their use can offer significant creative and educational value, the potential to create realistic yet false content further complicates the process of assessing its credibility. Research indicates that disinformation accompanied by deepfake content can be perceived as more convincing and trustworthy, highlighting the need to develop the skills to critically recognize and evaluate such material.

Changes in the media landscape indicate that the traditional understanding of media and information literacy needs to be re-examined and expanded. In the era of generative AI, it is no longer sufficient for an individual merely to be able to locate information and evaluate its source. One must also understand how the content was created—whether it was generated or modified using AI—how algorithms influence its presentation and dissemination, and what the potential consequences of its use might be. Consequently, alongside the traditional components of media and information literacy, AI literacy, algorithmic literacy, and critical thinking are becoming increasingly important.

AI literacy entails more than just the technical ability to use AI-based tools. It encompasses understanding the fundamental operating principles of AI systems, recognizing their capabilities and limitations, critically evaluating their outputs, and comprehending the ethical and societal aspects of their use. In this context, Long and Magerko (2020) conceptualize AI literacy through competencies that enable an individual not only to use AI systems but also to understand them, critically evaluate them, and perceive their impacts.

These changes hold particular significance for the education system. Schools are tasked not only with developing traditional digital and information skills but also with preparing students for critical and responsible participation in an environment where artificial intelligence is becoming part of everyday learning, communication, and content creation. In its AI competency frameworks, UNESCO emphasizes the need for students to develop capabilities related to a human-centric approach, AI ethics, the understanding and application of technologies, and the design of AI systems. In this way, students are viewed not merely as technology users, but also as critical thinkers, responsible citizens, and potential co-creators.

Alongside the need to develop new competencies among students, the question of teachers' competencies also arises. In the modern educational environment, the teacher is not merely a user of digital technologies but a facilitator who guides students toward the critical, ethical, and responsible use of information and technology. Consequently, their level of awareness, attitudes, competencies, and readiness to integrate AI into teaching are of particular importance.

Through its AI Competency Framework for Teachers, UNESCO emphasizes the need to rethink the teacher's role in the era of artificial intelligence. The framework organizes teacher competencies into five areas: a human-centric approach, AI ethics, AI fundamentals and applications, AI-integrated pedagogy, and AI for professional learning. This indicates that teacher competence in the AI era is not limited to technological knowledge but also encompasses the ability to use technology in a critical, ethical, and pedagogically sound manner.

This gives rise to the need to examine media literacy in the era of synthetic media not only from the perspective of students but also through the knowledge, attitudes, and perceptions of teachers. It is particularly important to investigate the extent to which teachers are informed about synthetic media, how they perceive generative AI and its application in education, and whether they consider existing concepts of media and information literacy sufficient to address these new challenges.

In this context, this paper addresses media literacy amidst the emergence and spread of synthetic media and generative artificial intelligence, with a particular focus on the perceptions of primary school teachers. The study aims to examine teachers' level of awareness regarding synthetic media, their attitudes toward the use of generative AI in education, and their perceptions regarding the need to develop and redefine educational competencies. Special attention is given to the possibilities of integrating AI literacy, algorithmic literacy, and critical thinking into the modern concept of media and information literacy.

The scientific relevance of the research stems from the need to determine whether transformations in the contemporary media ecosystem require a corresponding re-examination of educational goals and competencies. In a landscape where synthetic media are increasingly difficult to distinguish from authentic content, the ability to critically analyze, verify, and evaluate information becomes an essential educational necessity. Gaining insight into teachers' perceptions can contribute to identifying professional development needs, enhancing teaching practices, and creating modern educational approaches that address the challenges of a media environment shaped by generative artificial intelligence.

2. Literature Review

Modern society is characterized by the rapid development of information and communication technologies and a constant increase in the volume and diversity of information. While the digital environment enables quick access to and sharing of information, it simultaneously creates challenges regarding its accuracy, credibility, and relevance. In this context, media and information literacy are essential competencies for critical and responsible participation in modern society.

Media literacy is traditionally associated with the ability to access, understand, analyze, and critically evaluate media content, as well as to create and share it. Information literacy refers to the ability to recognize the need for information and to locate, evaluate, and use it appropriately. These two fields are interconnected and form the foundation for the critical use of information.

UNESCO views media and information literacy as an integrated framework of knowledge and skills for accessing, understanding, analyzing, evaluating, using, and creating information and media content, while placing special emphasis on the role of education and teachers (Wilson et al., 2011; Grizzle et al., 2021). Its importance is growing in the educational context, as students are exposed to various forms of digital content from an early age and need to develop habits of information verification and critical thinking.

Digital transformation has changed the way information is created, distributed, and consumed. The internet, social networks, and digital platforms enable users to be both consumers and creators of content simultaneously. This creates opportunities for learning and communication, but also risks exposure to inaccurate, manipulative, and disinformation-laden content.

Algorithmic systems that influence the selection, ranking, and display of content pose an additional challenge. Personalization can affect the information a user accesses and their understanding of reality. Therefore, modern media and information literacy entails not only analyzing a specific message but also understanding the broader digital and algorithmic context.

Under such conditions, critical thinking and the verification of sources become essential. Users need to be able to ask questions regarding the author, purpose, source, evidence, and potential interests behind specific content. Consequently, algorithmic literacy emerges as a significant additional dimension of modern media and information literacy.

The development of generative artificial intelligence has led to the emergence and rapid refinement of synthetic media—content created or modified, either wholly or partially, using algorithms and AI. This encompasses text, photographs, audio, video, and other forms of digital content.

A particularly significant characteristic of synthetic media is their ability to generate realistic content, thereby complicating the distinction between authentic and artificially created material. This raises questions regarding trust, authenticity, authorship, and accountability.

Deepfake content attracts particular attention; by employing deep learning techniques, it enables the creation or alteration of a specific individual's appearance, voice, or behavior. Although such content can serve creative and educational purposes, it also carries risks of fraud, manipulation, privacy violations, and the spread of disinformation.

McCosker (2024) highlights the need to link media literacy with AI literacy and data literacy so that users can better understand the technologies and processes through which digital content is created. Harris (2024) further emphasizes the challenge of verifying the authenticity of synthetic media, noting that technical detection should be complemented by critical assessment. The issue of deepfake content is also significant for trust in media and public communication (Labuz and Nehring, 2024).

Generative artificial intelligence enables the creation of text, images, audio, video, and other multimodal content based on given instructions. In education, it can be used to prepare and adapt teaching materials, create assignments, generate ideas, personalize learning, and support teachers.

UNESCO recognizes generative AI as a technology with significant potential for education but emphasizes that its application must be human-centric, ethical, safe, and pedagogically sound (Miao and Holmes, 2023). Issues related to data privacy, bias, academic integrity, and the responsible use of technology are of particular importance.

One of the key challenges is the potential for generative systems to produce convincing yet factually incorrect information. Consequently, their outputs should be verified and cross-referenced with reliable sources. This underscores the need to foster critical and ethical competencies among teachers and students.

The emergence of generative AI expands the traditional concept of media and information literacy. Modern users must not only be able to locate and evaluate information but also consider how it was created and whether artificial intelligence played a role in the process.

Generative technologies enable the rapid creation of vast amounts of text, visual, audio, and video content. While this holds significant potential for education and creative expression, it simultaneously creates opportunities for the production and dissemination of manipulative and false content.

Consequently, modern media literacy must encompass verifying sources, assessing authenticity, recognizing potential signs of manipulation, and understanding the capabilities and limitations of generative AI.

The development of generative AI and algorithmically mediated platforms necessitates an expansion of traditional media and information literacy models. Beyond accessing, analyzing, and evaluating content, AI literacy and algorithmic literacy are becoming increasingly important.

AI literacy entails understanding the fundamental principles, capabilities, and limitations of artificial intelligence systems, as well as using them critically and responsibly. Algorithmic literacy refers to understanding how algorithms influence the creation, selection, ranking, and distribution of digital content.

These competencies are closely linked to critical thinking. While critical thinking enables the evaluation of information and evidence, AI literacy facilitates an understanding of the technology, and algorithmic literacy—an understanding of the processes through which digital platforms mediate access to information.

The ethical dimension is also significant, encompassing privacy protection, copyright, the recognition of bias, and the responsible use of AI.

Teachers play a pivotal role in developing students' media and information literacy. Their role extends beyond the mere use of digital tools; it encompasses fostering the ability to critically evaluate, verify, and responsibly use information.

In the era of generative AI, teachers must help students understand that digital content is not necessarily human-generated and that its realistic appearance is no guarantee of its truthfulness. Consequently, teachers serve as vital intermediaries between students, technology, and the modern information landscape.

Successfully fulfilling this role requires modern digital, media, information, and AI competencies. Professional development should encompass not only the use of specific AI tools but also an understanding of their capabilities, limitations, risks, ethical aspects, and pedagogical applications.

Research to date indicates growing interest in the relationship between media literacy, digital competencies, artificial intelligence, and education. Particular attention is being paid to teachers' readiness to use generative technologies and their ability to critically evaluate AI-generated content.

Research indicates that technical knowledge of technology is insufficient for its effective educational application; pedagogical, ethical, and critical competencies are also required. Regarding synthetic media, the literature shows that identifying them cannot rely solely on technical detection systems but necessitates the development of broader media, information, and AI competencies. UNESCO emphasizes that the rapid development of generative AI creates a need to build human capacity for its safe, ethical, and pedagogically sound use (Miao and Holmes, 2023).

In the Macedonian educational context, digital transformation and the development of competencies for using new technologies are becoming increasingly significant. However, there remains a need to examine the extent to which existing initiatives address the specific challenges associated with generative AI, synthetic media, AI literacy, and algorithmic literacy.

A review of the literature indicates that the development of generative AI and synthetic media is creating a new media environment in which issues of authenticity, trust, authorship, and the methods of information creation and distribution are gaining added importance.

Although existing literature extensively examines the technological capabilities and risks of generative AI and its application in education, further research is needed regarding teachers' perceptions, attitudes, experiences, and needs concerning synthetic media and generative AI.

It is particularly important to examine teachers' level of awareness, their assessment of the opportunities and risks, their readiness to integrate these issues into their teaching, and the need for professional support.

Therefore, the study of primary school teachers' perceptions regarding media literacy in the era of synthetic media and generative AI aims to contribute to a better understanding of their knowledge, attitudes, and needs. In this context, contemporary media and information literacy should be viewed broadly, by linking critical thinking, AI literacy, algorithmic literacy, information literacy, and the ethical use of digital technologies.

3. Research Methodology

The research methodology in this paper is based on combining theoretical analysis with empirical research, with the aim of examining primary school teachers' perceptions of media literacy in the era of synthetic media and generative artificial intelligence. The theoretical part is based on an analysis and review of relevant contemporary scholarly literature in the fields of media and information literacy, synthetic media, and generative artificial intelligence, with a particular focus on new competencies related to AI literacy, algorithmic literacy, and critical thinking. The theoretical analysis enables the definition of the research's conceptual framework and the identification of contemporary challenges and opportunities arising from the development of generative artificial intelligence within the educational process.

The empirical component is designed as a quantitative, descriptive, and non-experimental study conducted using a survey method. The research focuses on teachers' levels of awareness, attitudes, experiences, and perceptions regarding synthetic media and generative artificial intelligence, as well as their assessment of their own readiness to critically recognize and evaluate content created or modified using these technologies. The primary objective of the research is to determine how teachers perceive the role of media and information literacy amidst rapid technological development and the increasing prevalence of synthetic media and generative artificial intelligence. Additionally, the study aims to assess teachers' level of awareness, their attitudes toward the opportunities and risks associated with using generative AI, their self-assessment of their own competencies, and the need for further training and professional support.

One hundred and twenty primary school teachers participated in the study. Participation was voluntary, and the anonymity and confidentiality of the respondents' answers were ensured. To capture diverse perspectives, the study included teachers with varying levels of professional experience and differing degrees of prior exposure to and experience with digital technologies and artificial intelligence-based tools.

A structured questionnaire, designed based on relevant scientific literature and the research's theoretical framework, was used as the primary data collection instrument. The questionnaire covered key aspects of the subject matter: media and information literacy, synthetic media, generative artificial intelligence, AI literacy, algorithmic literacy, critical information assessment, and the ethical use of technology. A Likert scale was used to examine teachers' attitudes and perceptions, while other questions addressed their demographic and professional characteristics, as well as their prior experience with digital technologies and generative AI tools.

The collected data were processed using descriptive statistical methods. The analysis provided insight into the teachers' level of awareness, attitudes, and self-assessment regarding synthetic media and generative AI, and helped identify their needs for further professional development.

This methodological approach enabled the linking of theoretical insights with empirical data, creating a more comprehensive picture of how primary school teachers perceive the opportunities, challenges, and risks associated with synthetic media and generative AI. At the same time, the findings can contribute to identifying the need to develop modern media, information, AI, and algorithmic competencies among teachers, as well as to enhancing educational practices amidst dynamic technological and societal changes.

4. Findings

The empirical study covered a total of 120 primary school teachers in the Republic of North Macedonia. The research aimed to examine their level of awareness, attitudes, and perceptions regarding media and information literacy, synthetic media, and generative artificial intelligence, as well as to assess their readiness to use these technologies critically and responsibly within the educational process.

The results show that teachers recognize media and information literacy as a significant competence in modern digital society. Particular emphasis is placed on the need to equip students to critically evaluate information, verify sources, and recognize potentially manipulative or inaccurate content. This finding indicates that media literacy is perceived not merely as the ability to use media and digital tools, but also as a prerequisite for critical and responsible participation in the information society.

Regarding synthetic media, the results indicate limited awareness among some teachers, particularly concerning the terms "synthetic media" and "deepfake." At the same time, the respondents recognize the possibility of digital content being created or altered using artificial intelligence, viewing this as a new challenge for media literacy. This perception is significant because the realism of visual, auditory, or textual content can no longer, in itself, be considered a sufficient indicator of its authenticity.

Findings related to deepfake technology further highlight the need to develop skills for the critical assessment of digital content. Educators recognize the potential for the misuse of synthetic media through the spread of disinformation, manipulation, and the creation of false portrayals of events or individuals. Consequently, recognizing synthetic content is becoming an integral part of modern media and information literacy.

Regarding generative artificial intelligence, the results reveal a range of attitudes among teachers. On the one hand, generative AI is recognized as a potentially useful tool for facilitating the teaching process, preparing instructional materials, and personalizing learning. On the other hand, respondents express concerns regarding the accuracy of generated information, the potential for misinformation, ethical dilemmas, and the potential misuse of the technology.

A particularly significant finding is the view that information obtained through generative AI should be verified before being used in teaching. This result confirms that generative AI should not be used as a substitute for critical thinking, but rather as a tool requiring human judgment, verification, and contextualization. In this regard, critical thinking stands out as one of the key competencies for navigating the modern information environment.

The results also point to the need to expand the traditional understanding of media and information literacy by developing AI literacy and algorithmic literacy. Teachers recognize these competencies as significant for the modern teacher and student, particularly given the growing influence of algorithmic systems on the creation, selection, and distribution of digital content. In this context, a media-literate user needs not only to know how to find and evaluate information but also to understand that the way such information is presented to them may be shaped by algorithmic processes.

One of the significant findings concerns the professional preparedness of teachers. Although some teachers demonstrate interest and enthusiasm regarding the use of generative AI, the results indicate a need for further professional development. There is a particular need for practical training on recognizing synthetic media, verifying AI-generated information, ensuring the safe and ethical use of generative AI, and integrating it into the teaching process.

Responses to the open-ended questions further deepen the picture obtained through the quantitative part of the research. Teachers view the role of generative AI as twofold: as an opportunity to facilitate and enhance teaching, but also as a source of new risks requiring a critical approach, clear rules, and ethical standards. Their responses highlight the need for additional training, the availability of appropriate teaching resources, improvements to digital infrastructure, and the establishment of clearer guidelines for the use of AI in education.

It is particularly significant that teachers link the use of generative AI to the need to develop new competencies in students. Beyond the traditional aspects of media and information literacy, they recognize the need for AI literacy, algorithmic literacy, critical thinking, and ethical digital responsibility. These findings point to a shift in the perception of the teacher's role: from a transmitter of information to a mediator who helps students critically understand, verify, and use information within a complex digital environment.

Overall, the research findings indicate that the traditional understanding of media and information literacy is insufficient to fully address the challenges posed by synthetic media and generative artificial intelligence. The new media landscape requires expanding existing competencies to include knowledge and skills related to recognizing and verifying synthetic content, understanding algorithmic processes, critically evaluating AI-generated information, and using technology ethically.

The findings also confirm the pivotal role of teachers in this transformation. Their awareness, competence, and readiness to use new technologies are crucial prerequisites for fostering media and information literacy among students. Consequently, the results highlight the need for continuous professional support, systematic training programs, and clear educational policies that address generative AI not merely as a technological tool, but as a new factor in the development of media and information literacy.

5. Discussion and Conclusions

Research findings indicate that the development of generative artificial intelligence and the emergence of synthetic media are creating new challenges for media and information literacy in primary education. The modern digital environment is transforming not only the accessibility of information but also how it is created, modified, selected, and distributed. Therefore, the traditional understanding of media literacy—focused on accessing, analyzing, and critically evaluating media messages—needs to be expanded to include competencies related to recognizing synthetic content, understanding algorithmic processes, and critically evaluating information generated with the help of artificial intelligence.

In this context, the findings indicate that teachers recognize the significant role of media and information literacy in preparing students for active and responsible participation in the digital society. Of particular importance is the ability to verify sources, cross-reference information, and critically assess its credibility. These skills take on added significance in an environment where synthetic media enable the creation of content that can be visually, auditorily, or textually convincing, even though it is not authentic.

Understanding synthetic media and deepfake content is a significant aspect of modern media literacy. The results indicate a need for further information and professional training for teachers to recognize and critically evaluate such content. This is particularly important because the realism of digital content can no longer, in itself, be considered proof of its authenticity. Instead, assessment should be based on verifying the source, context, and available evidence, as well as considering the possibility that the content was generated or altered using artificial intelligence.

Teachers' perceptions of generative AI reveal its dual nature within the educational context. On the one hand, generative AI is recognized as a potentially useful tool for preparing teaching materials, generating ideas, creating activities, and supporting personalized learning. On the other hand, risks associated with inaccurate or biased information, misinformation, privacy, authorship, and the ethical use of the technology are identified. Therefore, the educational value of generative AI should be viewed not only through its technical capabilities but also through the teacher's ability to critically evaluate its outputs and use them in alignment with educational goals.

A particularly significant aspect of the discussion is the need to develop AI literacy and algorithmic literacy as new dimensions of media and information literacy. AI literacy entails understanding the fundamental principles, capabilities, and limitations of artificial intelligence systems, while algorithmic literacy refers to understanding how algorithms influence the selection, ranking, and distribution of digital content. Linking these concepts with critical thinking creates a foundation for more responsible and secure participation in the digital society.

These findings confirm the need to view the teacher's role more broadly than merely the technical use of digital tools. The teacher becomes a key intermediary between students, technology, and the information environment. Consequently, the teacher's professional preparedness is a crucial prerequisite for fostering critical thinking and media literacy among students. Professional development should encompass practical knowledge regarding the use of generative AI, as well as the critical evaluation of AI-generated content, the recognition of synthetic media, data protection, copyright issues, and the ethical aspects of AI usage.

In terms of the formulated hypotheses, the research enables an examination of the relationships between teachers' experience with AI tools, their awareness of synthetic media, their perception of risks, and their need for professional support. The acceptance or rejection of the hypotheses is determined based on the statistical analysis of data obtained from the 120 respondents.

Research shows that the emergence of synthetic media and generative AI necessitates a re-examination and expansion of traditional concepts of media and information literacy. In an environment where text, visual, audio, and video content can be rapidly created or modified using AI, mere access to information is no longer sufficient. Skills for verifying, comparing, and critically analyzing information—as well as assessing its authenticity, credibility, and context—are essential.

In this context, AI literacy, algorithmic literacy, and critical thinking should be viewed as complementary competencies to modern media and information literacy. Integrating them into the educational process can help foster students who not only use new technologies but are also able to critically understand their capabilities, limitations, and potential risks.

The research confirms the significant role of teachers in this process. Their competence and readiness for the critical and ethical use of generative AI are important prerequisites for developing appropriate competencies in students. Therefore, continuous professional development programs are needed to integrate the technical, pedagogical, critical, and ethical aspects of AI use in education.

At the institutional level, the results point to the need for clear educational policies and a systemic approach to integrating artificial intelligence into teaching. Such an approach should simultaneously foster innovation and provide mechanisms to protect against disinformation, technology misuse, privacy breaches, and other potential risks.

In a broader sense, fostering media, information, and AI-literate citizens is a crucial prerequisite for responsible participation in the digital society. Therefore, the education system needs to evolve by integrating these new competencies into curricula, teacher professional development, and teaching and learning practices.

Ultimately, the research contributes to an understanding of the evolving role of media literacy in the context of synthetic media and generative AI, and highlights the need for further empirical research, particularly within primary education. Future studies could examine differences among teachers based on their professional experience, levels of digital competence, and prior experience with AI tools, as well as the impact of professional training on their readiness to use generative AI critically and ethically.

6. Limitations and Directions for Future Research

When interpreting the research findings, certain limitations must be taken into account. The study was conducted on a sample of 120 primary education teachers in the Republic of North Macedonia; consequently, the generalizability of the results to the entire teacher population—as well as to teachers in secondary and higher education—is limited. Furthermore, the voluntary nature of participation may influence the sample composition, particularly if teachers with a greater interest in digital technologies and artificial intelligence were more inclined to participate in the study.

The use of a self-report questionnaire presents an additional limitation. Although this method is suitable for examining teachers' perceptions, attitudes, and self-assessments, self-reported levels of knowledge and competence do not necessarily align perfectly with their actual knowledge and practical abilities. Therefore, future research could combine survey data with practical tasks and assessment tools designed to evaluate teachers' ability to recognize synthetic and AI-generated content, verify digital sources, and critically evaluate information.

The results should also be considered within the specific temporal and technological context in which the research was conducted. Generative AI and synthetic media are dynamic fields characterized by rapidly evolving technologies, tools, and application methods. Consequently, teachers' perceptions and levels of awareness may shift as AI tools become more widely available and integrated into education, and as relevant policies and professional development programs are developed.

The research focuses primarily on teachers' perceptions and self-assessments; it does not directly involve students, nor does it examine the actual application of generative AI in teaching practice through observation. Consequently, it is not possible to fully determine how teachers' attitudes and levels of preparedness translate into classroom activities and the development of students' media, information, and AI literacy. This presents a significant opportunity for further research.

Future research needs to encompass larger and more diverse samples, including teachers from various regions and educational levels, as well as students. This would allow for a more comprehensive understanding of the situation and create conditions for comparing different educational contexts. Comparative studies involving other European educational systems would be particularly valuable for identifying best practices and models for developing media, information, and AI literacy that could be applied within the Macedonian educational context.

Future research should also devote greater attention to examining the effects of teacher professional development programs. It is necessary to determine whether training focused on AI literacy, algorithmic literacy, the recognition of synthetic media, and the critical assessment of information contributes to improving teachers' knowledge and practical competencies. Longitudinal studies would be particularly valuable for tracking changes in knowledge, attitudes, and teaching practices during the period of intensive integration of generative AI into education.

An additional avenue for research involves examining the impact of generative AI on teaching practices, the development of students' critical thinking, academic integrity, and the ways in which students evaluate digital information. In this context, it is also necessary to investigate how students recognize AI-generated and manipulated content and what strategies they employ to verify its credibility.

A particularly significant area for further research is the development and evaluation of educational models that integrate media and information literacy, AI literacy, algorithmic literacy, and critical thinking. Such models could serve as a foundation for developing teaching materials, practical guidelines, and professional development programs for teachers.

At a systemic level, future research can provide an empirical basis for advancing educational policies regarding the responsible integration of artificial intelligence into education. In doing so, alongside technological aspects, it is necessary to consider issues related to privacy, authorship, disinformation, algorithmic bias, academic integrity, and the ethical use of generative AI.

Overall, the stated limitations do not diminish the significance of the research but rather highlight the need for further, in-depth study in this field. The rapid development of generative artificial intelligence and synthetic media necessitates a continuous re-evaluation of the competencies required for modern education. In this regard, future research should contribute to the creation of evidence-based models and practices that equip teachers and students for critical, safe, ethical, and responsible participation in the modern digital information environment.

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