THE IMPACT OF SUDDEN CHANGES ON THE PROFESSIONAL DEVELOPMENT AND LEARNING OF KINDERGARTEN TEACHERS

A HIRTELEN BEKÖVETKEZŐ VÁLTOZÁSOK SZEREPE AZ ÓVODAPEDAGÓGUSOK SZAKMAI FEJLŐDÉSÉBEN ÉS TANULÁSÁBAN

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Abstract

From a policy perspective, the Hungarian public education system has entered a new phase of digital strategy implementation, which includes the integration of AI tools and platforms in pedagogical and managerial processes. While these initiatives offer opportunities for innovation, they also challenge traditional notions of pedagogical autonomy, experiential knowledge, and teacher agency. Preschool teachers must now navigate a landscape in which continuous learning is not only encouraged but implicitly demanded by systemic digitalization. This research seeks to explore how kindergarten teachers internalize and respond to these pressures. What are their primary responses to the integration of artificial intelligence? How do they transform their learning behaviors and collaborative practices in this changing environment? Using a qualitative methodology, the study aims to provide a more nuanced picture of the intersection of technology, professional identity, and learning culture in the learning process of preschool teachers. The study presents the main findings of the focus group discussions. It then interprets the results in light of relevant theoretical perspectives and concludes with conclusions on future research directions.

Keywords: artificial intelligence, preschool teachers, professional development, learning, digital adaptation

Összefoglalás

Politikai szempontból a magyar közoktatási rendszer a digitális stratégia megvalósításának új szakaszába lépett, amely magában foglalja a mesterséges intelligencia eszközök és platformok integrálását a pedagógiai és irányítási folyamatokba. Noha ezek a kezdeményezések innovációs lehetőségeket kínálnak, egyúttal kihívást jelentenek a pedagógiai autonómia, a tapasztalati tudás és a tanári önállóság hagyományos fogalmainak is. Az óvodapedagógusoknak most olyan környezetben kell boldogulniuk, ahol a folyamatos tanulás nem csak ösztönözve van, hanem a rendszerszintű digitalizáció implicit módon meg is követeli. Ez a kutatás azt vizsgálja, hogy az óvodapedagógusok hogyan internalizálják és reagálnak ezekre a nyomásokra. Melyek az elsődleges reakcióik a mesterséges intelligencia integrációjára? Hogyan alakítják át tanulási magatartásukat és együttműködési gyakorlataikat ebben a változó környezetben? A kvalitatív módszertan alkalmazásával a tanulmány célja, hogy árnyaltabb képet adjon a technológia, a szakmai identitás és a tanulási kultúra metszéspontjáról az óvodapedagógusok tanulási folyamatában. A tanulmány bemutatja a fókuszcsoportos beszélgetések főbb eredményeit. Ezután a releváns elméleti perspektívák fényében értelmezi az eredményeket, és a jövőbeli kutatási irányokról szóló következtetésekkel zárul.

Kulcsszavak: mesterséges intelligencia, óvodapedagógusok, szakmai fejlődés, tanulás, digitális alkalmazkodás

Introduction

Sudden and unexpected changes in life situations can influence teachers' professional development in various ways. The COVID-19 pandemic presented educators with challenges that required immediate response, as the closure of educational institutions necessitated the implementation of teaching in an online, remote format.

In the practice of preschool teachers, the digital working structure was previously less known, and their experience in establishing and managing online work relationships was also limited, since they had – and continue to have – daily, in-person contact with both children and parents. As Bíró (2020) notes in his study based on interviews with preschool teachers, the online development of children required a shift in professional mindset. For this shift to occur, the widespread use of information and communication technologies became indispensable.

In the interest of professional renewal and methodological exchange, during this period, preschool teachers increasingly began visiting professional community platforms. From the perspective of the digital transition in education, it was crucial for teachers, institutional leaders, educational organizers and researchers, as well as policymakers, to be able to interpret new developments with a systems-thinking approach. Numerous studies were conducted by researchers to understand these challenges (Bond, 2021).

Paradigm Shift in the Context of Learning

The focus of professional and policy recommendations has shifted toward the need for teachers' professional development, a sustained funding of applied tools, the promotion of equity pedagogy, and the development of collaborative practices (Horváth et al., 2021). The continuous advancement of educational technologies and methods is fundamentally transforming the present and future of education. New solutions often make learning more efficient or more enjoyable—both critical aspects. The application of up-to-date methods is especially important in educating younger generations that are growing up in a technology-rich environment and prefer modern, experience-based learning opportunities. Following these trends not only offers benefits for learners but would also ease the workload of educators (Komenczi, 2002).

Echoing the views of Morris (2010), it can be stated that the information and telecommunications revolution of the past fifty years has profoundly transformed the conditions and possibilities for human information processing and communication. The need for the digitalization and virtualization of learning environments has appeared at all levels of education: public education, higher education, adult learning beyond higher education, and library services. These changes inevitably influence the professional development and in-service training opportunities for teachers. Online platforms, applications, and social media have made learning more accessible, flexible, and personalized than ever before. Technology now enables individuals to become lifelong learners, regardless of their physical location.

The Challenge of the Continuous Transformation of the Digital Environment

Technological development and the widespread use of information tools not only reshape the means of learning but also redirect the evolution of human capabilities. According to the research of Gyarmathy (2012) and Pléh (2015), these changes are rearranging the psychological and cognitive foundations of learning, while also compelling the reform of teaching methods.

Technological changes have a significant impact on educational culture and the need for its renewal. Cordes (2009), as cited by Koltay (2010), points out that among the new principles of literacy, information and communication competences now occupy a central place. Information literacy and its levels – such as digital literacy or ICT competence – have become essential conditions for competitiveness in the 21st century.

In a digital society, information literacy is one of the basic prerequisites for successful participation. It goes beyond the mere technical ability to use tools. As Rab (2007) emphasizes, information literacy is a broader concept than tool competence: it refers to "the ability to access and use information" (Rab, 2007, p. 183). Based on this broader interpretation, information literacy does not only aim to develop technical skills but also includes the ability to navigate among information, to critically evaluate it, and to apply it meaningfully – competences that are fundamental for succeeding in digital-age learning and work environments.

This requires a new way of thinking. As we enter an era in which more and more activities are performed using digital devices, a new type of intelligence – called digital intelligence – is needed to perform tasks efficiently and effectively. According to the World Economic Forum and the DQ Institute, digital intelligence is a complex set of competencies that goes beyond technical skills and includes cognitive, social and ethical dimensions (Chung et al., 2019). International research also highlights that the development of teachers' digital competencies is closely linked to the quality of children's digital experiences, so ongoing professional support for kindergarten teachers is a key factor in preparing them for the challenges of the digital age (Falloon, 2020).

Artificial Intelligence (AI) in the Professional Development of Preschool Teachers

The emergence and rapid development of artificial intelligence (AI) have had a significant impact on our everyday lives, including the world of education. The opportunities offered by technology bring with them new challenges and risks that influence not only our daily routines, work, and experience acquisition but also fundamentally alter the context of learning. As the pace of technological advancement accelerates, it becomes increasingly necessary to transform pedagogical culture – affecting communication practices, methodological approaches, and how learning itself is interpreted (Kissné Zsámboki, 2023).

In recent decades, AI has revolutionized the technological environment, especially in education, where it has opened up many new opportunities. The application of AI is particularly relevant for the professional development of kindergarten teachers, since artificial intelligence, as a digital tool, is already present in everyday life – including the lives of young children. They grow up with these technologies, live with them, and are influenced by them. However, it is important that preschool children receive age-appropriate information about them. To do this, the teachers working with them must have up-to-date professional knowledge.

The Application of AI in Supporting Educational Task

Both international and national examples highlight that the future has already begun, and it is only a matter of time before tablets, interactive whiteboards, robots, and other digital tools become widely present in Hungarian preschools. With the general proliferation of mobile devices and the development of educational technologies specifically designed for young children, the toolkit available to preschool teachers continues to expand.

Pedagogical applications of AI make it possible to develop methods and strategies that emphasize not only technological skills but also experiential learning (Southwork et al., 2023). Continuous professional development of preschool teachers is essential for the effective use of AI systems. Understanding and integrating new tools into educational processes requires specific competencies that must be supported by appropriate training programs.

It is essential to establish a supportive environment at both the systemic and local levels. Support from institutional leaders and the encouragement of staff collaboration – with opportunities for peer learning – would facilitate the adoption and dissemination of innovative practices.

Research Methodology, Sampling Procedure

The research examines the responses and reactions of kindergarten teachers to factors influencing their professional development. What are their primary responses to the integration of artificial intelligence? How do they transform their learning behavior and collaborative practices in this changing environment?

This study used a qualitative research method. Due to the exploratory nature of the study and the emphasis on recording personal experiences, semi-structured focus group interviews were considered the most appropriate method.

The research sample consisted of 5 focus groups, selected from different institutions in Hungary. The focus groups were selected based on maximum variation sampling, ensuring diversity in terms of age, years of professional experience, geographical location and size of institution. The participants were of different ages and professional experience, as shown in Figure 1, Figure 2, Figure 3, Figure 4, Figure 5, and are currently active in the field.

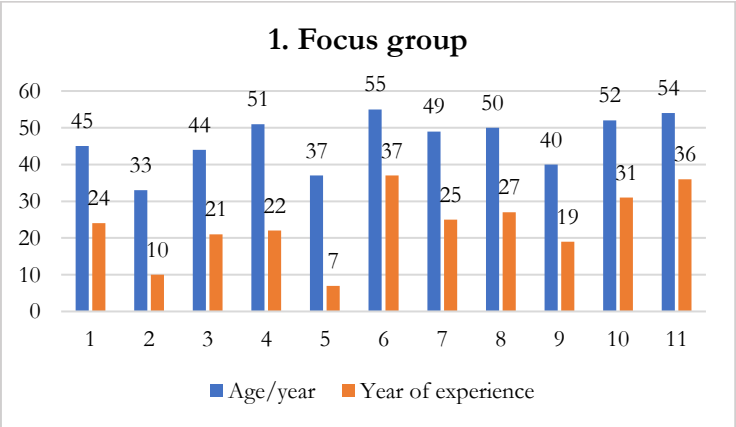

Figure 1 Age and years of professional experience distribution of members of focus group 1

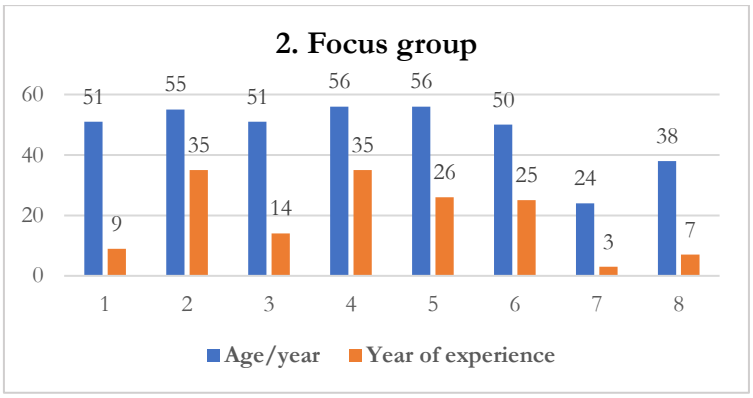

Figure 2 Age and years of professional experience distribution of members of focus group 2

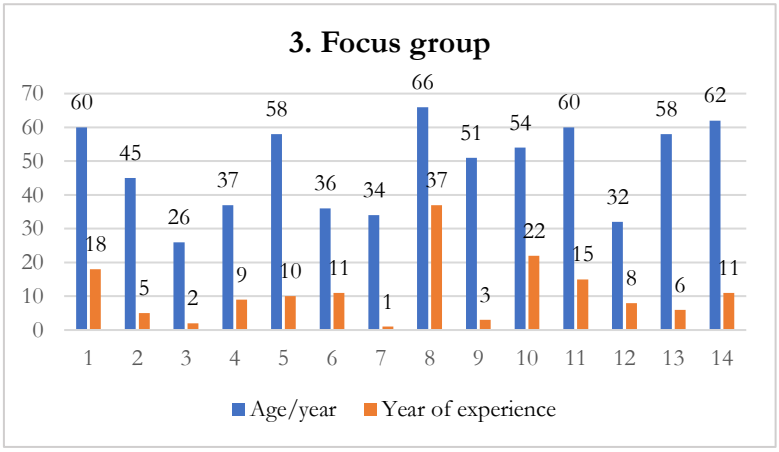

Figure 3 Age and years of professional experience distribution of members of focus group 3

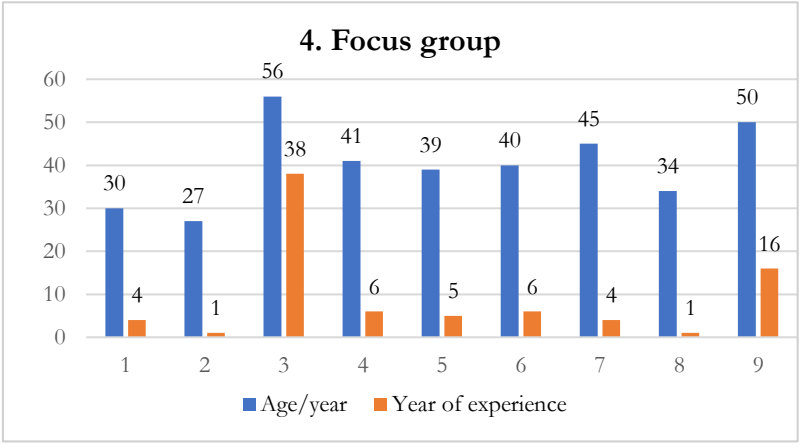

Figure 4 Age and years of professional experience distribution of members of focus group 4

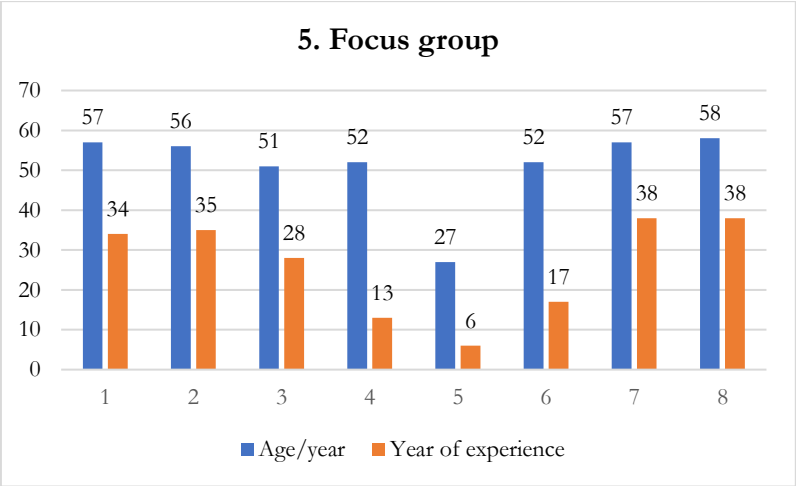

Figure 5 Age and years of professional experience distribution of members of focus group 5

The five focus group sessions took place between December 2024 and March 2025, each lasting approximately 90 minutes. The discussions were conducted using semi-structured interviews, which examined kindergarten teachers' opinions on artificial intelligence, changes in their professional learning routines, emotional reactions to digitalization and the role of peer support. All sessions were audio-recorded, transcribed and anonymized to ensure confidentiality. Thematic analysis was applied following Braun and Clarke's (2006) six-phase approach. Transcripts were initially coded inductively, allowing themes to emerge from the data. Codes were refined through iterative reading, and themes were validated through cross-checking by two independent researchers.

As a first phase of the analysis, the interview transcripts were read in full several times to gain a comprehensive picture of the kindergarten teachers' experiences and opinions. During this process, notes were taken on initial impressions and recurring thoughts. After reading the interviews several times, the researcher assigned a code to each passage that referred to the kindergarten teachers' perceptions, emotional reactions, learning practices, or institutional experiences with AI. Inductive coding allowed codes to be derived directly from the data rather than from pre-defined categories. Codes were grouped into thematic units that reflected recurring patterns in the kindergarten teachers' experiences. For example, codes for "emotional ambivalence" (fear, curiosity, distrust) appeared in a larger thematic cluster. Each identified theme was detailed, named, and refined in terms of its contribution to answering the research questions.

This resulted in four final main dimensions:

- (1) emotional ambivalence and uncertainty,
- (2) the emergence of informal learning,
- (3) changing views on professional development,
- (4) critical reflection on institutional support structures.

In the final stage of the analysis, the researcher selected quotes from the transcripts that directly reflected the thoughts of the kindergarten teachers, supporting the themes. The quotes were given an illustrative role, ensuring that the analysis was based not only on the researcher's interpretation, but also on the participants' own voices.

Analyzing Kindergarten Teachers' Perceptions of Artificial Intelligence Use

This analysis is based on qualitative data from five focus group interviews conducted with a total of 53 kindergarten teachers working in various state-maintained Hungarian kindergartens. The aim of the research was to explore teachers' perceptions of artificial intelligence (AI), its perceived relevance in their professional context, and its influence on their professional learning and development. The findings are presented across four key dimensions: (1) emotional ambivalence and uncertainty, (2) the emergence of informal learning, (3) changing views on professional development, and (4) critical reflection on institutional support structures.

Emotional Ambivalence and Uncertainty

While all participants (100%) were familiar with the concept of artificial intelligence, only 27% had actually used AI in any form in their pedagogical work – mostly to generate visual materials (e.g., posters, images) or for creative tasks like writing lyrics. The integration of AI was described as emotionally overwhelming and ambivalent by many. Teachers expressed a mixture of curiosity, anxiety, resistance, and fascination.

Most participants emphasized their lack of preparedness, describing AI as "distant" or "not designed for the kindergarten environment." A significant proportion (73%) stated that AI seemed disconnected from the realities of preschool education and more relevant to administrative or academic contexts.

"We don't use it; it still seems distant in our profession."

Moreover, 45% raised ethical concerns, particularly related to how AI might affect children's cognitive development and intrinsic motivation to think independently. "If we type in a question and get an answer right away, will children still learn to think?"

Several participants also expressed concern that the integration of AI into administrative or assessment tools might pose a threat to pedagogical autonomy. These reflections point to a deeper tension between technological innovation and pedagogical values rooted in human interaction, active learning, and developmentally appropriate practices.

The Emergence of Informal Learning

Kindergarten teachers acquired their knowledge of AI exclusively through informal learning channels. A majority (64%) indicated that family members – especially their own children – were their primary source of knowledge about AI. Additionally, 45% had voluntarily experimented with AI tools in their private lives, typically using them for creative purposes such as generating lyrics or designing posters. "We use it at home – for lyrics, posters. It gives interesting ideas."

Learning in this context was:

- Contextual – rooted in everyday personal or digital experiences,
- Non-institutional – disconnected from any formal workplace training structures,
- Unstructured and self-directed – lacking any professional guidance, reflection, or pedagogical framework.

Despite the absence of formal or non-formal training opportunities, teachers are increasingly forming spontaneous peer learning networks. These include professional Facebook groups, shared

online documents, and informal after-hours discussions. Peer collaboration has emerged as a key strategy for navigating AI tools, reducing technological anxiety, and building digital confidence.

Changing Views on Professional Development

Artificial intelligence has not yet been integrated into structured professional development for early childhood educators. However, interest in AI is growing. Approximately 36% of participants viewed AI as a potentially useful tool, especially for administrative tasks, content creation, or project planning, but not as a core pedagogical resource.

Traditional models of professional development still dominate teachers' preferences, such as face-to-face workshops, peer learning, and hands-on practical training. Several respondents expressed dissatisfaction with formal training programs, describing them as too abstract or disconnected from daily teaching practices.

"Traditional training is theoretical and doesn't reflect our everyday reality." A shift was observed toward "just-in-time learning", involving self-initiated online tutorials, webinars, and personal experimentation. This trend reflects a growing move toward autonomous, needs-based professional learning.

However, three primary barriers continue to impede deeper AI integration into teachers' professional mindsets:

- A lack of technological confidence (reported by 73%),
- The perception that AI is irrelevant to early childhood education, which relies heavily on physical interaction and emotional engagement,
- A sense of generational and cognitive distance from emerging digital tools and platforms.

These findings highlight the need for both conceptual and skill-based shifts, supported by institutional structures that align with the realities of preschool education.

Critical Reflection on Institutional Support Structures

The final theme revealed a complete absence of institutional support for AI-related training and implementation. None of the participants had access to AI-focused workshops, educational materials, or professional learning communities. No local, regional, or national initiatives were mentioned that aimed to facilitate AI integration into preschool education.

"We have not used it in our work. It is simply not present in our professional environment." Despite these shortcomings, the data portray teachers as adaptive, critical, and resourceful. While some resist the fast pace of technological change, others are actively organizing their own learning environments. Their responses reflect both flexibility and concern, indicating that any effective AI integration strategy must be grounded in the specific needs, constraints, and capacities of early childhood professionals.

In summary, the research results show that:

- Kindergarten teachers are familiar with the concept of AI, but they rarely use it in practice.
- Learning occurs in an informal and self-directed manner, mainly through family and peer channels.
- They see the potential usefulness of AI more in administrative and creative tasks, but their pedagogical relevance is disputed.
- Due to the complete lack of formal training and institutional support, teachers self-organize, which shows both flexibility and uncertainty.

Potential Benefits of Artificial Intelligence in Preschool Teachers Professional Development of kindergarten teacher

Personalized Learning

According to Mező (2018), developing teacher competencies that support personalized learning is essential, as it requires breaking down traditional, routine-based thinking and active participation in the learning process. AI-based systems can take into account teachers' individual needs and learning styles, allowing them to develop at their own pace. With the help of artificial intelligence, teachers can select training programs tailored to their needs, thereby increasing the effectiveness of their learning (Vergolini, 2023).

Access to the latest scientific results

Search engines and digital databases supported by artificial intelligence – such as Google Scholar, Semantic Scholar and Scite – allow teachers to quickly and efficiently access the latest research and professional resources. This supports independent research, continuous professional development and keeping up with the latest educational trends (Koehler & Mishra, 2009). According to a survey by Dringó-Horváth and Dombi (2020), training programs that offer online learning elements and digital competence development are particularly valuable for teachers. The research highlights that educators are open to using e-learning solutions, ensuring that training opportunities are available anytime and anywhere, and allowing continuous contact with the latest scientific content.

Potential challenges of AI in the professional development of preschool teachers

Challenges often arise due to different levels of digital competence and prejudices – fears about the use of digital tools and AI. However, it is not the tool itself that influences users, but its function and the way it is used. Therefore, the more comprehensively teachers understand a given tool, the more useful, creative and conscious they can use it.

Lack of technological knowledge

Although AI offers many benefits, not all preschool teachers have the necessary technological knowledge to use these tools effectively. AI-based systems can be complex and learning to use them can be challenging for teachers (Ertmer & Ottenbreit-Leftwich, 2010). Lack of technological knowledge can hinder the development and utilization of AI tools. The literature emphasizes that the success of teaching with digital tools depends largely on the attitude of teachers and the extent to which they are supported by training (Hew & Brush, 2007). Without adequate training, teachers cannot fully exploit the opportunities offered by artificial intelligence.

Solving this problem requires comprehensive and targeted policy interventions aimed at developing teachers' digital and artificial intelligence competencies. At the same time, there is a need to

create supportive learning environments, such as AI-based tutors or mentoring chatbots, that can facilitate professional development and learning (Redecker, 2017).

Ethical and security concerns

The use of AI raises a number of ethical and security concerns, particularly around the protection of children's data. Preschool teachers need to understand how to handle children's data and be aware of the implications of using AI (Cohen, 2019). Ethical concerns can complicate teachers' decision-making regarding the use of AI tools and hinder their professional development.

It is therefore essential that teachers have adequate knowledge of data security, data management and digital ethics. The use of poorly regulated or opaque AI systems can not only violate children's rights but also increase teachers' liability (UNESCO, 2021). Ethical uncertainties – for example, who is responsible for the consequences of recommendations generated by artificial intelligence – can impair teachers' decision-making autonomy and consequently hinder their professional development (Molnár, 2024).

Practical suggestions for the future

- Organizing targeted training courses adapted to the kindergarten context
- Building a digital mentor network to support local teacher communities
- Creating and disseminating ethical guidelines
- Collecting and publicly sharing domestic good practices

The development of critical thinking skills in education needs to be improved, especially, but not exclusively, in terms of its ethical use (Kasneci et al., 2023). Artificial intelligence does not replace the teacher, but with appropriate application it can contribute to creating a more modern, child-centered educational environment.

Conclusion

A survey of Hungarian kindergarten teachers clearly showed that the lack of institutional support structures is a significant obstacle to professional development related to artificial intelligence (AI). According to the survey data, kindergarten teachers do not have access to formal AI training opportunities, so they acquire new knowledge primarily through informal channels – family, colleagues or online communities. This trend is closely aligned with international literature, according to which teachers worldwide rely on informal networks and self-organized learning when structured, institutional professional support is lacking (Trust, Krutka & Carpenter, 2016). "Just-in-time" learning, which is based on independent experimentation, following webinars and using online learning materials, can also be observed in domestic practice, and is not only a local feature, but also a global trend. According to a study by Viberg et al. (2023) in six countries, teachers' confidence in AI is directly dependent on their technological self-efficacy and knowledge of artificial intelligence, a result that closely matches the Hungarian data: 73% of teachers participating in the study indicated that they lacked technological confidence. The relationship between confidence and competence can therefore be considered a determining factor not only in Hungary but also internationally.

In terms of professional development, both Hungarian and international experiences show that teachers are motivated to master new technologies, but that the effectiveness of learning depends on the provision of relevant and practice-oriented training forms. Riggs' (2025) research clearly showed that targeted professional development programs can strengthen teachers' technology integration skills in the long term, especially in the field of early childhood education, where the educational context increasingly requires a conscious and reflective digital presence.

The importance of informal learning is also supported by other international studies. Su's (2024) research in Hong Kong showed that teachers consider the acquisition of AI literacy to be crucial, but lack institutional and government support and curriculum guidelines. Tripathi's (2025) study of K–12 teachers in India also showed that teachers both recognize the administrative and learning-supporting benefits of AI, but also express critical concerns about the development of children's critical thinking. These experiences are almost entirely consistent with the statements of Hungarian kindergarten teachers, who emphasized that the application of AI should not be at the expense of children's independence and creative thinking.

A comparison of domestic and international experiences clearly shows that the results of Hungarian kindergarten teachers should not be interpreted in isolation, but rather fit organically into the global discourse examining the interaction of teaching and technology. The use of digital tools has become part of everyday life, so their presence in the kindergarten environment is inevitable. All this requires the responsible and reflective use of AI-based tools, which focuses on the professional development and conscious formation of attitudes of teachers. Heidt (2024) highlights that the ability to navigate the digital world is based on experiences acquired in early childhood, especially through the techniques and questioning strategies conveyed by kindergarten teachers. Accordingly, digital competence is crucial for kindergarten teachers to be able to interpret and manage children's digital experiences, thereby ensuring safe and age-appropriate technological socialization. Teachers therefore play a key role in ensuring that AI-based tools and content are used in line with pedagogical goals, promoting children's cognitive, social and emotional development. Therefore, continuous professional development of kindergarten teachers is essential, which includes not only the development of their technical skills, but also the strengthening of their ethical awareness, didactic strategies, and reflective thinking in the context of digital education.

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