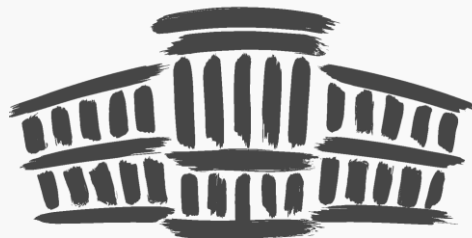


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## 11. КОНФЕРЕНЦИЈА „ИКТ У ОБРАЗОВАЊУ”

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## 11. IKT AZ OKTATÁSBAN KONFERENCIA

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## 11. KONFERENCIJA „IKT U OBRAZOVANJU”

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# TRENDS IN DIGITAL EDUCATION IN THE LIGHT OF TECHNOLOGY ADOPTION MODELS<sup>1</sup>

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## *Abstract*

Since the 1970s, a number of disciplines (psychology, economics, communication theory, educational technology) have been concerned with the identification of key factors related to the process of adoption of new technologies by different social groups as part of the process of adoption, elaboration, adaptation and diffusion of innovations. The aim of my presentation is to describe the most prominent models of technology integration based on a qualitative framework of criteria that I have developed. In addition, I will present the factors necessary for the success of technology integration in education, which was achieved by studying and analysing models available in other disciplines. In my presentation, I will outline the current trends in digital education and attempt to identify its current stage of adoption.

**Keywords:** *education, digital education, digital transformation, ICT integration, technology integration models*

## **1. Problem statement**

It is a globally accepted fact that the current industrial revolution has led to the digitalisation of many aspects of our lives, i.e. the emergence of digital (ICT) devices and the associated virtual dimension(s) through which we consume content. The internet as a medium has become part of our everyday life (Szűts, 2013) and with it new types of learning environments and new forms of learning support (Czeglédi, 2018) and competence expectations have changed, with the development of transversal domains coming to the fore (Kis-Tóth, Gulyás and Racsco, 2017; Lengyel, Racsco and Szűts, 2021)

The year 2023 marked a turning point worldwide, as applications of artificial intelligence became available to all which, along with the numerous opportunities, also brought fear to the surface, amplifying the need for a new kind of social adaptability expected by the VUCA world (Szűts, 2020). The changes brought about by new technological innovations are not new to societies, but in the age of the information society their pace of development has accelerated, speeding up the time it takes for adaptation to occur (Szűts et al., 2023)

The changes that take place during digital transformation are inseparable from social conditions (van Baalen-van Fenema and Loebbecke; 2016; Rhusby - Surry, 2016) and have an impact on all subsystems.

Models related to the adoption of (technological) innovations are present in the fields of communication theory, psychology, social psychology, economics, but also educational technology and didactics address the issue of technology adoption in relation to integration models.

The best-known models are related to diffusion theories, which aim to model and explain how an innovation spreads in society in a population; while elaborational adaptation theories help to understand

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<sup>1</sup> Készült „A STEM készségek fejlesztését támogató módszertani megújulás határon átnyúló összefogással – DigiTransz 2023-1-HU01-KA210-SCH-000157510 c. pályázat támogatásával”.

the intrinsic personal factors related to the acceptance or rejection of an innovation by individuals, as well as the related social processes (Straub 2009 cited in Niederhauser - Lindstrom, 2018).

The results of diffusion, adaptation and elaboration are the same: they induce change and, in some cases (e.g. in the case of digitalisation), lead to a paradigm shift in the long run.

It is also interesting to consider the many different senses in which the term innovation can be used. In a 2009 study, Baregheh et al. developed 60 different definitions of the term 'innovation', resulting in the following definition as a result of a meta-analysis: 'Innovation is a multi-step process whereby organisations transform ideas into new or improved products, services or processes in order to gain an advantage, compete with other market actors and differentiate themselves from competitors in the market.' (Baregheh et al., 2009, p. 1334.)

Precisely because of the dynamic nature of change in educational technology, we face a similar problem of 'confusion of abundance', as there is no single model for integrating new learning tools in education and understanding the processes involved. Thus, we need to look at theories from different disciplines to help pedagogues understand how and in what ways to integrate information technology and digital solutions into their pedagogical work.

## 2. Overview

### 2.1. The overview of the research

The aim of my research is to identify the factors necessary for the success of ongoing technology integration in different disciplines, which can be achieved by studying and analysing the models available in other disciplines.

In this context, I analyse the most significant technology integration models on the basis of a qualitative criteria framework that I have developed, and I present the factors that are necessary for the success of technology integration in education, which was led by the exploration and analysis of models available in other disciplines. In my work, I outline the current trends in digital education.

My sampling procedure was a theoretical-theoretical and multidimensional sampling, in which I investigated adoption models of innovations and specifically of technological innovations. The models and theories on which my research was based were selected using the systematic literature review method and the PRISMA protocol (Kővári, 2024). To analyse them, I used a non-interventional, non-reactive study, which involved content analysis, using inductive coding.

The studies used to describe the theories and models were organised according to a noncross-sectional layout, as follows:

#### Elaboration and diffusion models

- Communication theory aspect:
  - The Elaboration Likelihood Model of Persuasion (Petty & Cacioppo, 1986)
- Social psychological aspect
  - Actor-Network-Theory (ANT) Latour 1987).
  - Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975)
  - Theory of Planned Behavior (TBP) (Ajzen, 1991)
  - Social Cognitive Theory (SCT) (Bandura, 1986)
- Economic aspect:
  - Diffusion of Innovation Theory (Rogers, 2003; Rogers, Singhal & Quinlan 2014)
  - Disruptive Innovation Theory Christensen, (1997; Christensen & Raynor, 2003)

#### Technology adoption models:

- SCOT- Social Construction of Technology (Van Baalen , van Fenema & Loebbecke, 2016)
- Technology Acceptance Model (TAM1) (Davis, 1989)
- Technology Acceptance Model (TAM2) (Venkatesh et al., 2003)
- Unified Theory of Acceptance and Use of Technology (UTAUAT) (Venkatesh et al., 2003; Venkatesh, Thong & Xu, 2012)

In coding, I formed the following main categories (1) Individual's perspective (2) Nature of technology (3) Social aspect (4) Individual factors (5) Behavioural intention to use (6) Strategic aspect.

2.2. Results

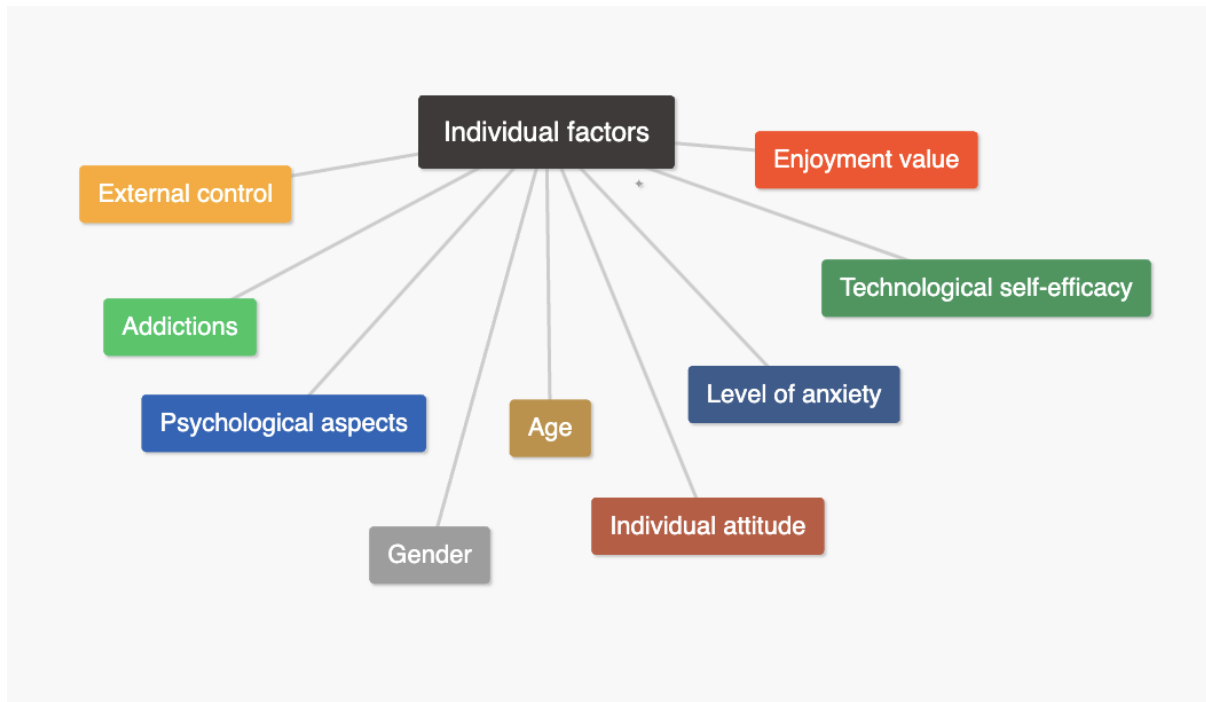
Inductive coding, followed by the development of the main and subcategories, yielded the following results.

The adoption of an innovation is dominated by the utility to the individual and the expected benefits of its application from the individual's perspective, which can be objectified in terms of intellectual, moral and material benefits. What others think about the innovation and the expected consequences of its application in the life of the individual are important elements. The degree of trialability, the ease of use for the individual and the time available for adaptation play a significant role in acceptance. Whether indirect reinforcement (rewards and punishments) is provided by others also plays a role (see Figure 1)



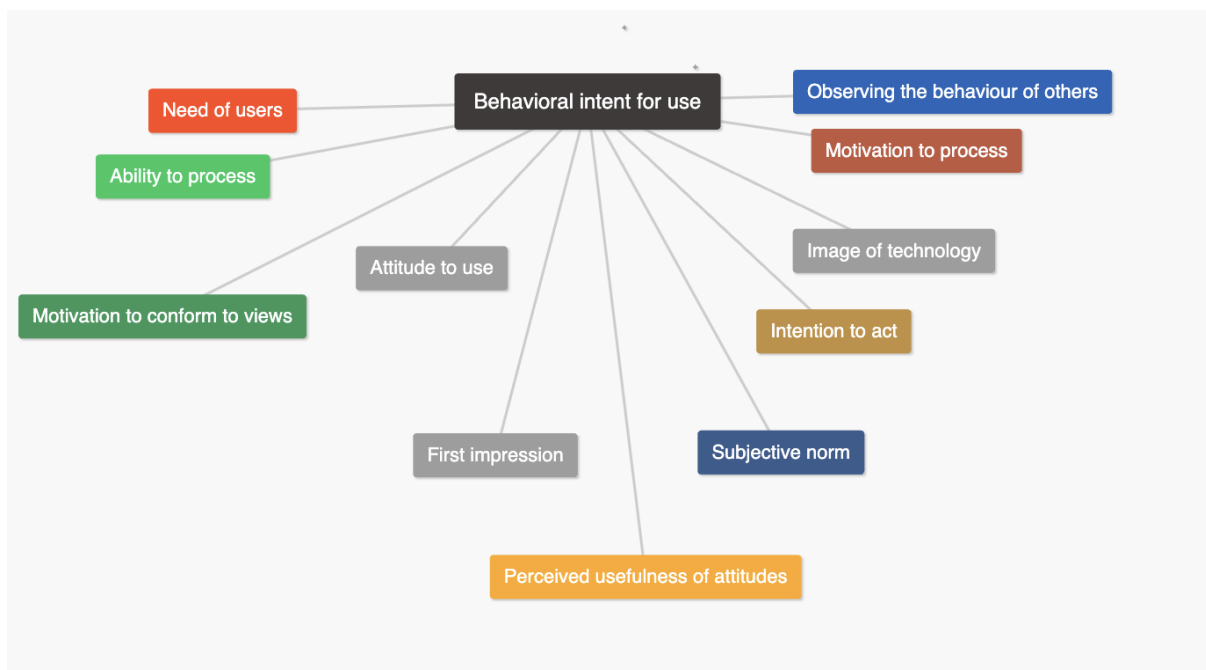
1. Figure: The elements of model in light of individuals prespective

When examining the characteristics of the individual, the gender, age and attitude of the subject are determinant, and psychological aspects are also important (e.g. susceptibility to addictions, importance of pleasure value, role of external control, and level of anxiety). In addition, the individual's view of self-efficacy is also reflected (see Figure 2).



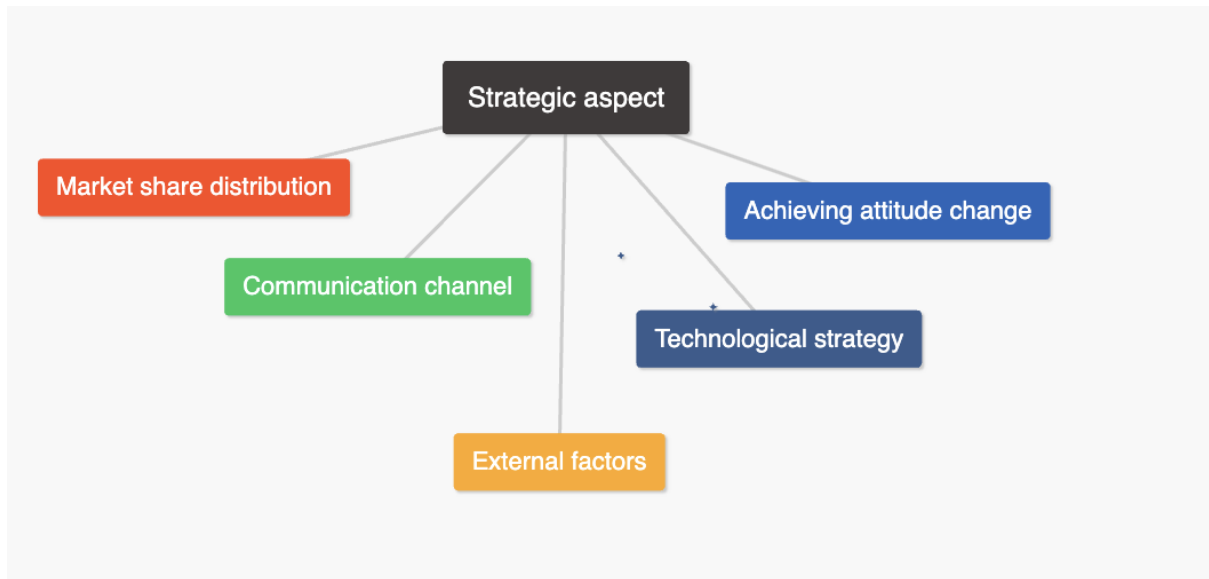
**2. Figure:** *The elements of model in light of individuals factors prespective*

Individual behaviour in the use of innovations is influenced by the observation of the behaviour of others, the needs and abilities of users, attitudes towards use, individual norms, motivations, intention to act, attitude towards use, image of the innovation and first impressions (Figure 3).



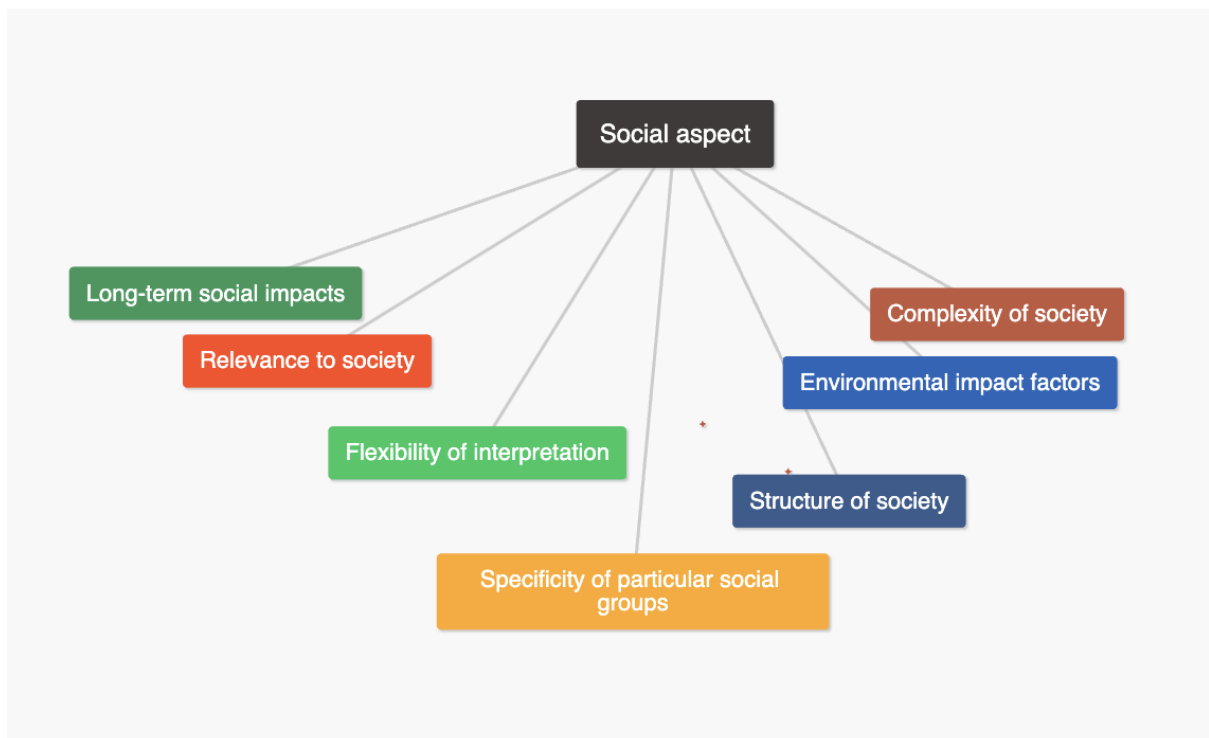
**3. Figure:** *The elements of model in light of behavioral intent for use prespective*

Besides individual factors, the models also analyse strategic and social perspectives. From a strategic point of view, the tools and methods needed to achieve attitudinal change, the communication channel used, the market share distribution, the strategy used and external factors are shown.



**4. Figure:** *The elements of model in light of strategic aspect*

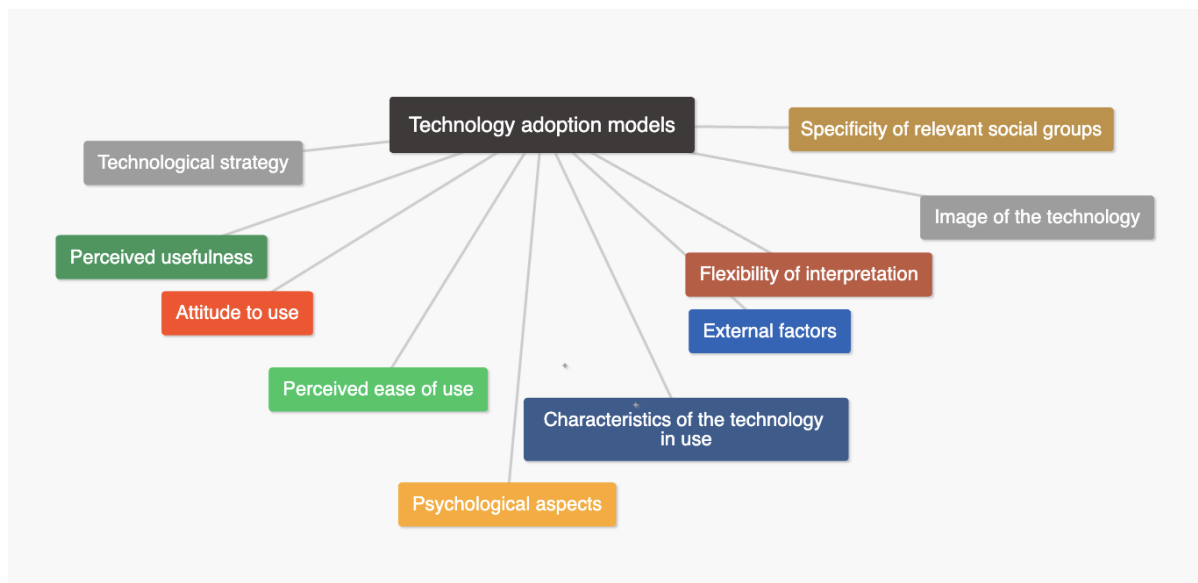
From a societal point of view, the specificities (structure, complexity) of the social groups concerned, the importance of the innovation for society, its short- and long-term implications and its environmental impact should be highlighted.



**5. Figure:** *The elements of model in light of social aspect*

In the case of technology-centred models, the structure of the factors in the adoption models is somewhat simpler, as attitudes towards use, perceived usefulness, the image of the technology, the specificity of the relevant social groups and external factors play a role. From the individual's

perspective, ease of use, psychological aspects and flexibility of interpretation play a role. Also important are the characteristics of the technology in use and the technological strategy used to capture it.(See Figure 6.)



6. Figure: The elements of model in light of social aspect

### 3. Overview of current trends in the digital transformation of education

As an experiment, ChatGPT, one of the best known artificial intelligence applications based on a large language model, was asked "What are the trends in educational technology (EdTech) in the field of education in 2024?" I consider the answer to the question (prompt) as part of the trend analysis. Of course, being aware that most of the predictions are speculative, but based on the ongoing developments, future directions can be sketched,

The following 10 trends have been identified: virtual reality (VR) and augmented reality (AR); artificial intelligence (AI) in education; online and hybrid learning; gamification; micro-content; blockchain technology in education; collaborative learning tools; student data analytics - data-driven learning; ethical and inclusive technology integration.

It is a long-established fact for education professionals that technologies that facilitate personalised learning have long been present in education (e.g. the emergence of teaching machines in 1920). This field is greatly facilitated by adaptive systems based on artificial intelligence and machine learning that take into account (and understand) the individual learning style, abilities and performance of learners and adapt to individual needs, ensuring personalised learning (Racsko and Kis-Tóth, 2019)

Different, new types of learning environments (network-based, blended, online and hybrid) have become increasingly accepted after the COVID-19 pandemic (Antal, 2023, Szűts és mtsai, 2023) and have been further developed in many areas in different segments of education to support learning, ensure learning flexibility and content accessibility (Racsko; Kis-Tóth and Gulyás, 2015)

Closely related to this are micro-content based learning solutions, which implement the modularisation of textbooks into small units, along the appropriate methodology, using appropriate media content, providing continuous feedback on the progress of learners in the learning process.

The support of collaborative learning through digital tools is a priority, and the role of platforms and tools to facilitate collaboration between learners and teachers is growing, both because of labour market expectations and the effectiveness of socio-constructivist learning.

In digitally-based learning environments data-driven learning will play an even greater role, as schools can exploit the potential of Big Data analytics (data analysis) to gain an even deeper understanding of areas for improvement in student performance and personalise feedback based on data-driven assessments. Textbooks of the future can now be the basis for analysing large data sets and can form an integral part of teacher training.

The use of blockchain technologies can help with administrative tasks, issuing certificates, checking and keeping records.

Virtual reality (VR) and augmented reality (AR) applications are important tools for maintaining motivation, meeting the needs of new generations and experiential education, and can help students to learn through experience in digital spaces.

Tools and solutions for an ethical and inclusive implementation of digital technology integration, including data protection, digital equity, accessibility and access provision, will also play an important role.

In 2023, artificial intelligence will have burst into the public consciousness in the context of ChatGPT and many people will ask what such a tool can be used for pedagogical purposes (Lengyelne et al., 2024; Négyesi, 2024), in the process of learning and teaching. Today, there are predictions that artificial intelligence (AI) will become an important player in education, a useful "companion" for educators, from automating administrative tasks to providing intelligent tutoring systems that offer personalised learning paths and instant feedback to learners. This is not a replacement for teachers, but can make their work more effective. The development and use of AI is inevitable and useful, but only in certain areas.

Below is a brainstorming session on this topic (Bessenyi, 2023).

Detecting and analysing individual learning pathways and later mapping them

Monitoring students' work

Checking content (credibility)

The GPT as an idea generator, as a teacher's assistant

The technology trends outlined above cannot, of course, be adapted in the same way to all educational fields and contexts, but their application in a pedagogically appropriate way can bring a number of added values and increase the effectiveness of the learning-teaching process.

#### 4. Conclusions

The integration of new technologies is, as we have seen, a complex process that involves a number of factors, which, for a wide range of societies, implies systematic and continuous planning and monitoring.

From the trends presented here, it is clear how the digital transformation of education shares many common intersections with previous models of innovation and technology adaptation, which in the context of artificial intelligence in 2024, show patterns that can be applied to effectively integrate it into the learning-teaching process. Although emphasized in models, it should always be emphasized that it is not the learning tool (Antal, 2017), but individual factors and pedagogical goals that are at the heart of integration (Antal and Stókáné, 2015), the tool is just a new opportunity for methodological innovation (Racsko, 2024)

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