

Educators' Perceptions of AI and Climate Change in Hungary's Vocational Education

Viktória Varsányiné Szeredi
 Doctoral School on Safety and Security
 Sciences, Obuda University
 Székesfehérvár, Hungary
 szeredi.viktoria@phd.uni-obuda.hu

Zoltán János Trenka
 Alba Regia Faculty, Obuda University
 Székesfehérvár, Hungary
 trenka.zoltan@uni-obuda.hu

Monika Pogatsnik
 Alba Regia Faculty, Obuda University
 Székesfehérvár, Hungary
 pogatsnik.monika@amk.uni-obuda.hu

Abstract— Artificial intelligence (AI) and climate change are two of the most pressing global challenges, significantly influencing vocational education and training (VET). This study explores how teachers in transport and logistics education in Hungary perceive the anticipated impacts of AI and climate change on their professional roles and the broader socio-economic context. The research involved two samples: humanities teachers and vocational instructors from a VET center in Szekesfehevar using an online questionnaire. The survey assessed knowledge, attitudes, perceived risks, and openness to training related to AI and climate change. Results revealed mixed attitudes toward AI: while many teachers were open to its use, a large proportion, especially vocational teachers, viewed it as a security risk. In contrast, climate change elicited more consistent concern, with all vocational teachers agreeing on the need to prepare students for its effects. Generational differences were also observed, with Generation Y teachers showing more optimism toward AI and Generation Z teachers being more critical. The findings highlight the need for practice-oriented training programs that support AI integration and pro-mote sustainability education. With appropriate support, education can play a central role in addressing both technological and ecological challenges.

Keywords— Education, VET Teachers, Artificial Intelligence, Climate Change

I. INTRODUCTION

In the autumn of 2023, we launched the first phase of a broader research initiative aimed at exploring how global megatrends, particularly artificial intelligence (AI) and climate change, are influencing vocational education in Hungary. These two themes have become increasingly prominent in both international and national policy agendas, as they represent some of the most pressing challenges and transformative forces of the 21st century. AI is rapidly reshaping the nature of work, demanding new digital competencies and redefining professional roles across sectors [1]. At the same time, climate change is compelling industries to adopt more sustainable practices, which in turn requires a shift in the knowledge and skills imparted through education and training systems [2].

Our research focused on the transport, logistics, and supply chain sectors, fields that are especially sensitive to both technological innovation and environmental transformation. These industries are not only central to the functioning of the economy but are also undergoing significant change due to automation, digitalization, and the growing emphasis on sustainability [3]. As such, they provide a valuable lens through which to examine how vocational education is responding to these dual pressures.

The first phase of our work involved a systematic review of educational policy documents and curriculum frameworks to assess how AI and climate change are currently addressed in vocational training. This provided a foundational understanding of the institutional and curricular context in which educators operate.

Building on this groundwork, we conducted two rounds of data collection over the past year, engaging vocational teachers to better understand their perceptions of the challenges and opportunities associated with AI and climate change. These surveys captured a wide range of perspectives on how these global trends are expected to impact both professional practice and personal life.

This paper presents a thematic overview of the insights gained from these investigations. A central focus is the comparison of how educators perceive the relative impact of AI and climate change on their work and everyday experiences. By examining these perceptions side by side, we aim to uncover the underlying narratives that shape teachers' attitudes and to identify key trends that may inform the future development of vocational education. The findings offer a timely contribution to ongoing discussions [4] about how education systems can respond to complex, inter-related global challenges in a way that is both forward-looking and grounded in local realities.

II. OVERVIEW OF THE SAMPLES

During the research, data collection was conducted on two separate occasions, involving two distinct samples. In both cases, data were gathered using an online questionnaire. The first sample consisted exclusively of Hungarian language and foreign language teachers. This group is referred to hereafter as the "humanities sample." Data collection for this group took place between April 19 and April 26, 2024, resulting in a total of 67 completed responses.

The second round of data collection occurred between November 23 and November 30, 2024. This sample included instructors from two member institutions of the Szekesfehevar Vocational Training Center. A total of 33 responses were received from this group.

Although both surveys focused primarily on AI, they also included a limited number of questions related to climate change, more so in the vocational sample than in the humanities one. In terms of gender distribution, women were significantly overrepresented in both samples: 91% in the humanities group and 76% in the vocational group. This aligns with broader trends in education, where the profession is increasingly female dominated. These figures are consistent with national data, which show that women make up around

80% of the general teaching workforce and 63% in vocational secondary schools [5].

The average age of respondents was similar in both groups: 49.7 years in the humanities sample and 48 years in the vocational sample. The most common age was 54 in the humanities group and 50 in the vocational group, with median ages of 50 and 49, respectively. These results reflect the aging nature of the teaching profession in Hungary.

Generational analysis revealed that Generation X (born 1965-1980) was the most represented in both samples, while Generation Z (born after 1996) was the least. This is understandable, as many Gen Z individuals are still in education themselves. However, the low representation of Generation Y (born 1981-1996) is concerning, as this group should ideally be in the teaching workforce in greater numbers. The data confirm that the teaching profession is aging, with most respondents aged between 44 and 59, many of whom are approaching retirement.

III. EDUCATORS' EXPERIENCES WITH ARTIFICIAL INTELLIGENCE

In the initial phase of our research, we focused on analyzing educational background documents. Specifically, we examined how the goals of sustainable digital logistics and preparedness for the impacts of climate change are reflected in training pro-grams related to logistics and freight forwarding.

Logistics is a rapidly evolving industry where the effects of AI and digitalization are clearly visible. In the context of the industry 4.0, robotics and automation have become integral to production systems, material handling, storage, transportation, inventory management, and quality control. As a result of digitalization efforts with-in logistics systems, processes supported by information systems, such as intelligent logistics networks and cloud-based technologies, enable the delivery of customized products and services. This transformation demands innovation in skills and competencies. The labor market's evolving expectations, driven by technological advancements, necessitate the continuous updating of training systems and curricula [6].

These principles formed the foundation of the recent comprehensive reform of Hungary's vocational education system, as supported by pre-implementation re-search. Our document-based analysis revealed that although the "Vocational Training 4.0" strategy emphasizes practical, up-to-date, and labor market-relevant knowledge, this vision is only minimally reflected in the official curricula [7].

Subsequent research focused on how the rapid advancement of digitalization and the emergence of AI affect educators' work. The growing presence of AI has sparked societal debate regarding its usefulness and safety. Several researchers have noted that educators are concerned about workplace changes, the spread of misinformation, and threats to personal privacy [8]. The COVID-19 pandemic exposed significant gaps in digital competencies but also triggered a wave of innovation. De-spite the challenges, the pressure to adapt to new expectations led to AI being seen as a catalyst for progress, offering new opportunities in education [9]. While AI-based applications are often seen as helpful and convenient, they also raise ethical dilemmas and data security concerns [10]. The traditional role of the teacher as the sole source of knowledge is being redefined, as AI reshapes human

relationships and may diminish the authority of educators [11].

Looking ahead, and considering labor market expectations [12], the application of AI in education is important from three perspectives:

- Goal: understanding and teaching AI itself,
- Tool: using AI to provide effective support,
- Impact: leveraging AI's innovative potential to enhance both teaching and learning.

Based on these considerations, we conducted surveys among educators in both humanities and vocational fields. We asked humanities teachers about their aware-ness of and openness to AI-based applications. Among vocational educators, we extended the inquiry to include perceptions of safety and vulnerability.

Among humanities educators, 25% reported no familiarity with AI applications, while more than half actively use them. On a scale from 1 to 10, their average self-reported knowledge level was 4. Across generations, there were no significant differences in awareness or openness. Slightly more than 50% of teachers from all generations expressed willingness to use AI-based tools. In total, 32 different applications were mentioned.

In the vocational sample, educators rated their awareness and openness to digital and AI technologies at an average of 5.2 (on a 1–10 scale).

- 67% reported using AI-based applications.
- When asked about AI's impact on their subject matter and language use, humanities teachers gave average ratings between 2.6 and 3 (on a 1–5 scale), with Generation Y reporting the strongest perceived impact.

In the humanities sample, open-ended responses highlighted both positive and negative effects of AI, especially regarding students and their learning. Teachers were divided on creativity, some saw AI as enhancing it, others as diminishing it. Positive aspects included increased efficiency, support, engagement, motivation, and a sense of achievement. However, negative effects were noted in areas such as skill development, independence, and concentration. Interestingly, no respondents mentioned security concerns.

Among vocational educators, we focused on awareness, openness, and perceptions of risk and safety. As mentioned, their average awareness score was 5.2, while open-ness to digital thinking and transition scored higher at 6.5.

Concerns about AI-related risks and distrust are prevalent in society and among educators. Our findings confirmed this:

- 85% of vocational educators viewed AI as a security risk,
- 6% did not,
- 9% were unsure.

Generational analysis revealed that Generation Y viewed AI positively as a new opportunity, while no members of Generation Z expressed a positive view. Despite these concerns, when asked who AI poses the greatest threat to, 30% of vocational educators said it posed no threat to anyone.

However, 43% believed it was most dangerous for younger generations (see Fig. 1).

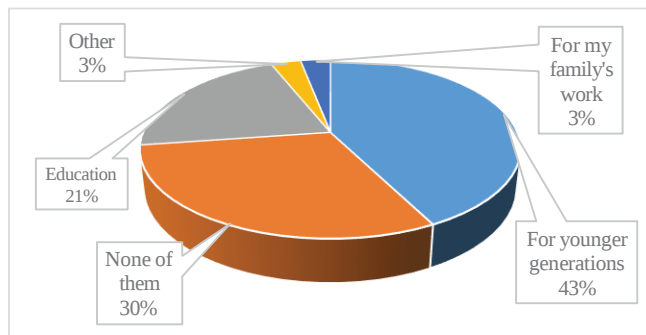


Fig.1. Assessing artificial intelligence vulnerability (professional education)

Both studies also assessed educators' willingness to participate in AI-related training

- Among humanities educators, 80% were open to training, while 15% were uncertain.
- Rejection of training was mostly limited to a few members of the Baby Boomer and Generation X.
- Language teachers were the most willing to participate.
- The vocational sample showed similar results:
- 88% were open to training,
- The remaining 12%, primarily Baby Boomers and Generation X, declined the opportunity.

Our research revealed that while educators approach AI with caution, their awareness is moderate, and they are generally open to development. They recognize the risks but are willing to engage with the opportunities AI presents.

IV. EDUCATORS' EXPERIENCES WITH CLIMATE CHANGE

The effects of climate change, especially recent weather anomalies, provide ample justification for integrating this topic into education. A striking example is Hungary's October 2024 average temperature, which exceeded the long-term average by 0.7°C, continuing a 17-month trend of above-average national temperatures [13].

Beyond temperature, climate change has broader implications. Dr. László Teknős highlights how climate change contributes to civilization-level conflicts and outlines the expanding responsibilities of disaster management authorities, supported by extensive data [14].

Climate change also affects the financial sector. In 2021, the Hungarian National Bank (MNB) [15] published a report emphasizing the integration of green considerations into monetary policy. The MNB demonstrated how climate-related risks influence the fulfillment of its core responsibilities.

Clearly, climate change impacts many aspects of life. In education, it is no longer sufficient to simply raise awareness about environmental protection and sustainability. Students must be prepared for the real-world consequences of climate change.

To support this preparation, it is essential to understand educators' perspectives and attitudes on the topic. In both of

our samples, we asked respondents whether they believed climate change or AI would bring greater changes to their personal lives in the next 5-10 years (see Fig. 2, Fig. 3).

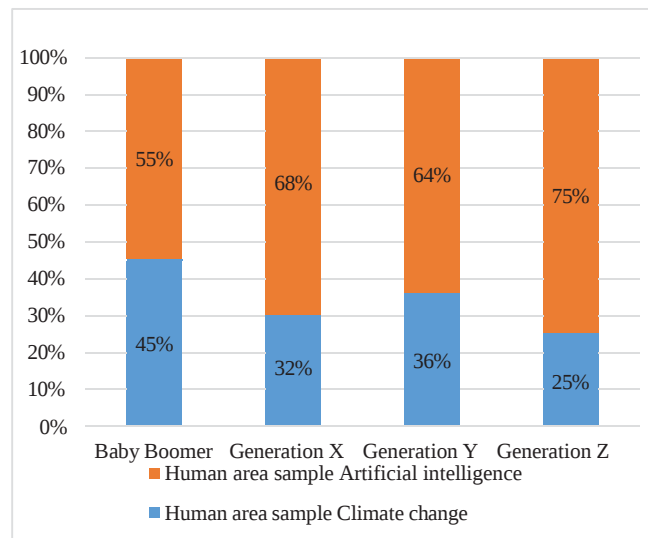


Fig. 2. Climate change or artificial intelligence will make a bigger difference in teachers' life in the next 5-10 years.

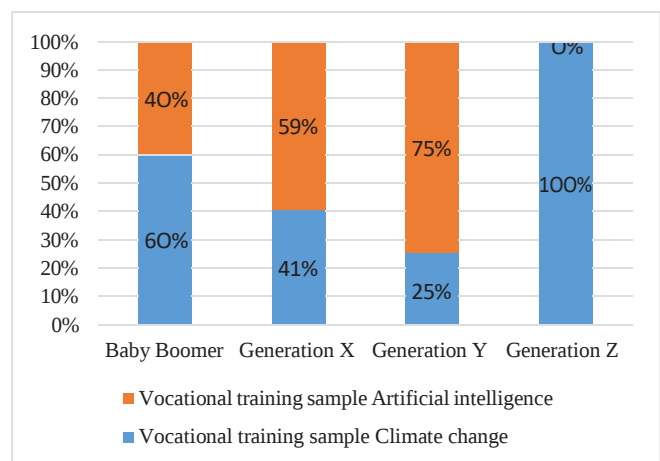


Fig 3. Climate change or artificial intelligence will make a bigger difference in teachers' life in the next 5-10 years.

It became clear from our analysis that in the humanities sample, artificial intelligence (AI) was consistently perceived as the more influential factor. Educators working in this field viewed AI as having a greater impact on their personal lives than climate change, across all generations. In contrast, the vocational training sample presented a more nuanced and mixed picture.

One particularly interesting finding relates to the differing responses of Generation Z across the two samples. In the humanities sample, 75% of Gen Z respondents considered AI to be a stronger influence on their personal lives than climate change. However, in the vocational training sample, 100% of Gen Z respondents identified climate change as the more significant factor.

We also asked participants:

“Which do you believe will have a greater impact on the economy and society over the next 5-10 years: climate change or the spread of artificial intelligence?”

The responses to this question were remarkably consistent across both samples. All generations agreed that AI would have a stronger influence on shaping the socio-economic system soon (see Fig 4., Fig. 5).

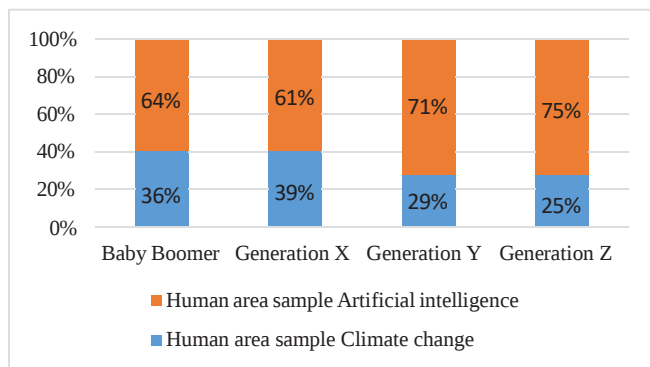


Fig 4. The perspectives of educators in the humanities regarding which factor, climate change or the spread of artificial intelligence, will have a greater impact on the economy-society system over the next 5 to 10 years.

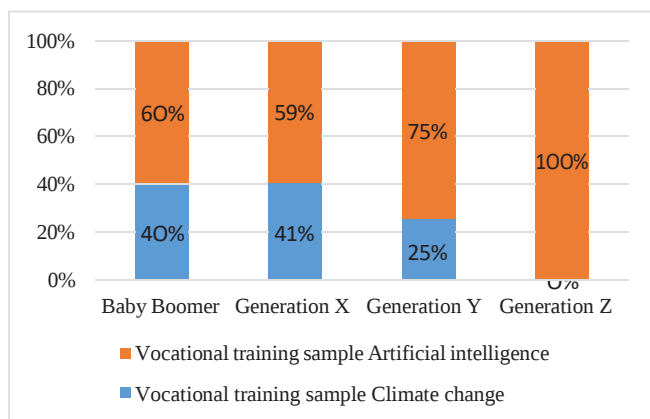


Fig 5. The perspectives of vocational trainers regarding which factor, climate change or the spread of artificial intelligence, will have a greater impact on the economy-society system over the next 5 to 10 years.

When analyzing both questions together, two key observations emerged:

1. Personal vs. Societal Impact Perception

In four instances, respondents rated climate change as having a greater impact on their personal lives than AI. However, when asked about the broader societal and economic impact, AI was consistently rated higher. These discrepancies were highlighted in Table 2 of the original study, with red shading indicating where climate change was rated higher for personal impact, and green where the values were equal.

This raises an intriguing question: Why do individuals perceive climate change as more impactful in their own lives, yet see AI as the dominant force at the societal level?

2. Generation Z's Divergent Views

Although the number of Gen Z respondents was low in both samples (a limitation to consider), their responses were notably different between the two groups.

– In the humanities sample, Gen Z respondents consistently rated AI as the more influential factor for both personal and societal impact.

– In the vocational training sample, Gen Z respondents saw climate change as the stronger influence on their personal lives, but AI as the more significant force shaping society and the economy.

This contrast prompts further reflection: Why do Gen Z educators perceive climate change as a stronger personal influence, yet not as a dominant societal force?

Although this aspect of the study was investigated exclusively within the vocational training sample, it yielded valuable insights into educators' attitudes toward climate change education. Participants were asked two key questions to assess their perspectives:

First, they were asked whether students should be prepared within the education system for the anticipated consequences of climate change. In response, all participants (100%) affirmed the importance of such preparation, indicating a unanimous consensus on the necessity of integrating climate-related content into educational curricula.

Second, respondents were asked whether they would be willing to voluntarily teach a subject focused on the phenomena and expected consequences of climate change, assuming no formal qualification requirements were imposed. In this case, 57% of the educators expressed a willingness to undertake such a role. These findings suggest a strong recognition among vocational educators of the importance of climate change education, with a majority indicating not only awareness but also a readiness to contribute actively to students' preparedness for future environmental challenges.

V. CONCLUSION

In summarizing our research, it is important to emphasize that our surveys are not representative due to the small sample size. Therefore, the findings offer only a limited insight into educators' attitudes and forward-looking perspectives regarding artificial intelligence (AI) and climate change. This limitation affects the generalizability of the results.

Even with this in mind, it is evident that both topics are of significant interest to the teaching community. Regarding AI, educators tend to approach the topic critically and with caution. However, they do not view it solely as a threat, they also recognize its potential and opportunities.

Overall, the data suggest that educators are open to training and development in both areas. The COVID-19 pandemic forced society into a rapid digital transition, which, despite its challenges, led to clear innovation. The role of the educator has undergone a substantial transformation in recent years, a shift accelerated by the rise of AI and digitalization. The open-mindedness demonstrated by educators in our study can serve as a model. The use of AI applications may support the education of new generations and better prepare students for the labor market. Our findings also show that AI-based tools offer numerous advantages: they can bridge generational gaps and enhance both teaching and learning.

Collaborative brainstorming among educators could help share positive experiences, demonstrate practical applications, and provide valuable support, especially for older generations of teachers.

In terms of climate change, educators clearly recognize the importance of addressing the topic and passing on related knowledge. However, when asked to weigh the impacts of AI and climate change on the economy and society, all generations identified AI as the more transformative force. This may be due to the more visible and immediate nature of AI's advancement, whereas the effects of climate change, though serious, are often perceived as slower or less tangible.

To raise awareness of climate change, the focus should not be on persuasion or fear, but rather on encouraging small, forward-looking steps. By integrating environmental awareness into education and preparing students for future challenges, the teaching profession can play a key role in mitigating the effects of climate change across all areas of education.

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