Between tradition and innovation: students' approach to AI in the context of experienced teaching methods

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Abstract

The strong development of artificial intelligence (AI) and its growing application in education are generating debate about its potential and challenges in higher education. This study aims to understand how students' experiences with differentiated active learning methods affect their perceptions of AI's role in academic education. A quantitative survey was conducted using a standardized survey questionnaire, including students from Poland, Romania, Greece and Croatia. The study used a quantitative approach, analysis was conducted in three analytical stages using (1) descriptive statistics, (2) hierarchical cluster analysis using Ward's method, and (3) a detailed description each of the identified groups, which allowed a comparison of their attitudes and experiences in the context of using artificial intelligence in education. The results show that students who have had experience with diverse teaching methods show more enthusiasm for AI, while those who prefer traditional methods are more cautious. Four distinct groups of students were identified who differ in their attitudes toward using AI in learning. The study underscores the importance of incorporating diverse teaching methods and educational technologies to support future competencies.

Keywords: artificial intelligence, active learning, teaching methods, higher education

1. Introduction

The strong development of artificial intelligence (AI) and the surge in its use in recent years [7], is generating debate about its role and potential it brings to higher education. This discussion raises both concerns about the risk of plagiarism and the hinderance in the development of student thinking skills, as well as the potential of AI in supporting learning processes focused on independence, creativity and collaboration [5],[9]. The potential of AI in education is immense and encompasses many dimensions of its application [23], most importantly, it enhances learning opportunities [16]. Tools, based on AI, can adapt educational content to unique learning styles and work pace [21]. Personalising learning increases engagement, improves motivation and learning outcomes [14].

Existing research confirms that experiencing a variety of teaching methods increases not only motivation [2],[18],[19] but also student adaptability [17].

Despite the many available studies focused on students' general attitudes, knowledge

and practices regarding artificial intelligence tools in their educational experiences [1],[4],[15], there is a lack of empirical research linking students' prior experiences with differentiated active learning methods to their readiness to use AI in education [1],[4],[15]. This is also confirmed by bibliometric analysis from Web of Science Core Collection, where we took into account all articles that contain the words "active learning" and "artificial intelligence" in their titles, abstracts and keywords. The diagram presents a co-occurrence network of keywords based on bibliometric data, which allows us to visualize and analyse the strength of relationships between the concepts of 'active learning', 'artificial intelligence', and 'education' in recent scientific literature. The diagram was prepared on the basis of 3,759 articles published after 2021 and 50 most closely related keywords. The diagram 1 shows the perspective on both phenomenon in the context of “education” as a keyword. The matter of this concept in the literature to combine active learning in the process of education is relatively new. For artificial intelligence the same holds true. Before 2023, terms were not so popular in the literature, but during 2023 and now the phenomenon of AI and active learning is strongly associated with “education”.

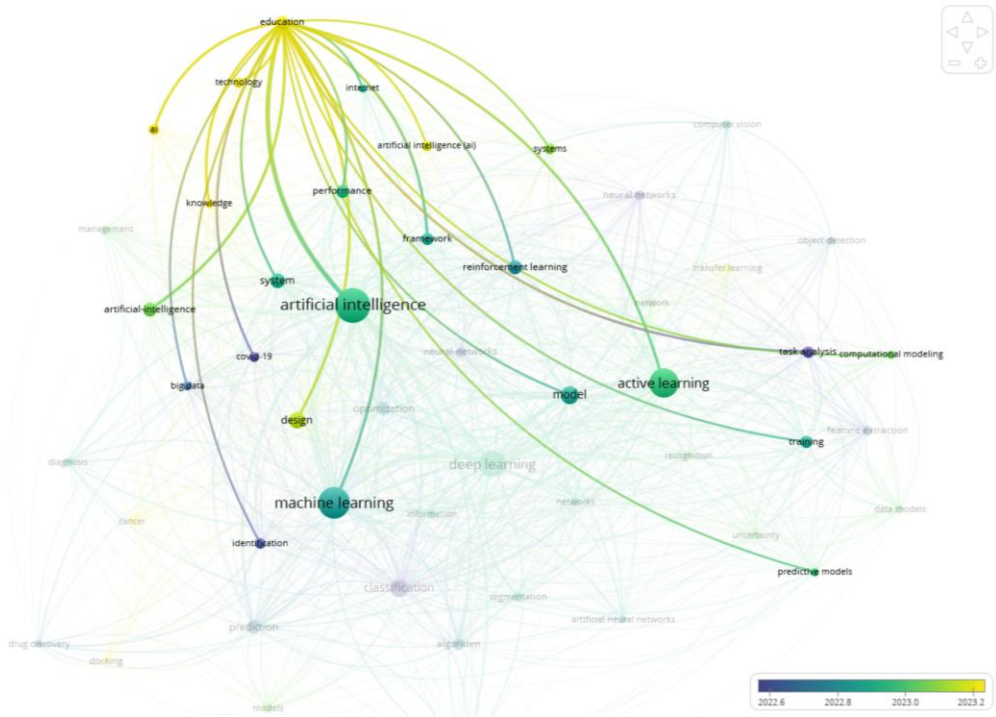

Diagram 1.

Diagram 1. The network of key words, based on the co-occurrence of education with AI and active learning. .Source: based on our study (VOSviewer).

To fill this research gap, a study was designed to determine how students' experiences with various teaching methods affect their perceptions of artificial intelligence.

In order to achieve the adopted research objective, a research question was defined:
RQ: How do students' experiences with different teaching methods affect their perceptions of the role of artificial intelligence in academic education?

The study used a quantitative approach based on a standardized survey questionnaire to investigate how students from the selected four European countries perceive artificial intelligence in education, which teaching methods they have experienced, and how this affects their assessment of AI's potential. In addition, cluster analysis explored differences between countries in attitudes toward using AI. The results reveal four distinct clusters of teaching experiences, varying in their attitudes toward AI from enthusiasm to caution.

The structure of the paper is as follows. After introduction, we provide the methodological framework. Section 3 presents results followed by conclusions.

2. Research methodology

The objective of the study is to investigate how students' experiences with different teaching methods affect their perceptions of artificial intelligence. In addition, differences in attitudes toward the use of AI by the countries studied were assessed.

The study used a quantitative approach, based on the analysis of data collected through a standardized survey questionnaire aimed at participants representing different countries and professional backgrounds related to the education, technology and applied sciences sectors. The survey sample included 730 respondents, diverse in terms of age, education level, country of origin and fields of study. The survey was distributed among the student population to whom the research team had direct institutional access, mainly through university mailing lists, academic platforms, and contacts through lecturers. The survey questionnaire is publicly available at the link (DOI: https://zenodo.org/records/15773165), ensures transparency and repeatability of the study. Participation in the study was completely voluntary and anonymous, and completion of the questionnaire was considered to be an expression of informed consent. The study did not involve sensitive personal data and was in line with general ethical guidelines for social research. It was conducted in Q2 and Q3 2024, covering Poland, Greece, Romania and Croatia – countries with a common socioeconomic background but different levels of digitisation [24]. The selection of countries was intentional and pragmatic, based on the research team's access to academic populations and the shared socioeconomic and regional context of Central, Eastern, and Southern Europe. This choice makes it possible to compare the experiences of students from different countries and verify their influence on perceptions of AI.

The survey was conducted in three analytical stages. In the first stage, descriptive statistics were developed for the entire sample. In the second stage, hierarchical cluster analysis (HCA) was applied using Ward's method, which made it possible to identify four homogeneous clusters of respondents based on response patterns [22]. In the third stage, a detailed description was made of each of the identified groups, which allowed a comparison of their attitudes and experiences in the context of using artificial intelligence in education.

The largest part of the sample was made up of those between the ages of 19 and 23, which accounts for more than half of all survey participants and also translates into a representation of the level of study – three quarters of the respondents declared participation in a first degree program (BA). Those continuing their education at the master's (MA) level were a distinct minority. This structure reflects the nature of the population covered by the study, which is dominated by young adults with still limited work experience, but who are in the active phase of forming academic and digital competencies. From the point of view of the subject of the analysis - the perception of solutions based on AI – such a sample structure may be important, as younger generations show a greater openness to new technologies, while not being deeply rooted in conventional models of work and education [8, 20].

Geographically, the sample was spread amongst four countries: Poland, Romania, Greece and Croatia. Respondents from Poland were the largest group (40%), while the other three countries were represented in similar proportions (Croatia 14%, Greece 25%, Romania 21%). Territorial differentiation captures possible cultural and institutional differences in the implementation of differentiated instructional methods and the perception of AI-based solutions, while maintaining relative regional consistency (all countries are of Central, Eastern and Southern European origin).

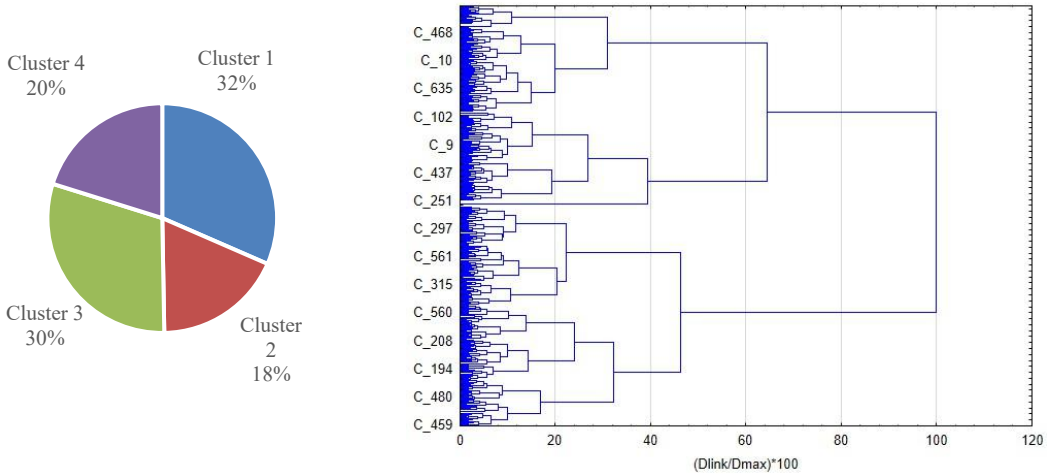

Fig. 1. Percentage of cases in four clusters obtained by Ward's method and Hierarchical cluster structure for the research sample
Source: Based on our study.

To explore the data in more depth, a hierarchical cluster analysis (HCA), based on Ward's method, was used to identify internally homogeneous subgroups of respondents based on similarities in their answers. Ward's algorithm, using a measure of Euclidean distance, minimizes the increase in total variance within clusters at each stage of merging [6],[11],[12]. This approach ensures high consistency of the internal groups, while making intergroup differences distinct. The clustering procedure was conducted based on participants' responses to questions regarding the frequency of their exposure to various active learning methods, such as group work, watching videos, discussions, reading articles, case studies, presentations, field work, peer assessment, and flipped classroom activities. These variables, recorded on ordinal scales (e.g., "never", "rarely", "often"), were used as input for the HCA using Ward's method.

The results of the analysis are presented in the form of a dendrogram (Figure 1), which highlights the clear division of the entire sample into four distinct clusters. The boundaries of the clusters were determined by analysing the level of merging (Dlink/Dmax), at which there is a significant increase in the distance between units – indicating the optimal cutting point of the hierarchy. The identified groups represent four differentiated response profiles, which forms the basis for further in-depth characterisation of these communities.

The percentage structure of the clusters indicates a relatively balanced distribution of the survey sample. Clusters 1 and 3 received the largest share of the collection, each comprising almost a third of all cases. Cluster 4 represents one-fifth of the cases, while cluster 2 turned out to be the least numerous, which may suggest its specific nature - perhaps a different competency profile, demographic profile or related to the perception of the role of AI.

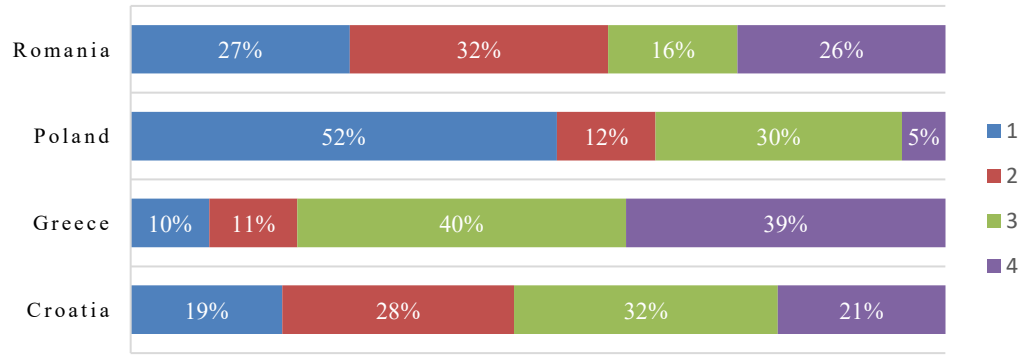

Fig. 2. Distribution of respondents in identified clusters by country
Source: Based on our study.

Figure 2 illustrates the distribution of respondents across the four identified clusters by country. The composition of the clusters varies significantly depending on regional affiliation. In Poland, cluster 1 (characterized by selective experiences in active learning) dominates, while in Greece and Croatia, clusters 3 and 4 (corresponding to low and moderate exposure to active teaching methods, respectively) prevail. Romania shows a more balanced distribution, although with a relatively strong representation of cluster 2 (very active learning environments). These differences may reflect institutional and cultural differences in pedagogical practices, as well as the degree of maturity in the implementation of digital and active learning in different national contexts.

3. Results

First of all, considering the experience of methods used in the classroom, there is a noticeable selectivity in their use in the case of cluster 1 (see Table 1). Cluster 1 respondents declare an overriding experience with group work, watching videos and discussions, which may be indicative of the dominant model of didactics based on interaction and collaborative content processing. It should be noted that forms more involving individual student activity, such as making presentations (by students), joint assessment of other students' work, and flipped classrooms, were relatively less common. As shown in Table 1, group work achieves 99% in this group, the highest score among all groups for a single method, while student-led presentations and peer assessment fall below 15%, confirming the interpretation of a model based on interaction but guided by the teacher.

Secondly, respondents assigned to Cluster 2 show unequivocally high levels of active participation in a variety of teaching forms, indicating an intensely diverse and modern educational environment. “Often” responses dominate in almost all categories, indicating the wide range of teaching methods used. Particularly notable is the regular use of forms such as watching videos, joint assessment of other student's work, discussions, group work, case studies and reading articles - these methods are widely regarded as conducive to the development of soft skills considered as competencies of the future, i.e. critical thinking, collaboration and self-reflection. Students in this group also report frequent contact with making presentations, field work and flipped classroom, which may indicate a greater degree of innovation in the educational institutions with which they are associated and attitude. Cluster 2 is the only group in which almost every method exceeds 60%, including techniques that are less frequently used in other clusters, such as peer assessment (88%) or case studies (67%), which suggests not only diversity but also consistency in the teaching approach.

Third, respondents belonging to Cluster 3 show relatively low exposure to active methods of knowledge perception. Most notable is the widespread absence of the group work method and also the limited participation of making presentations (by students) and flipped classroom - respondents rarely or almost never participated in this type of activity. Few also indicated field work, joint assessment of other students' work or reading articles. They did, however, participate, albeit to a limited extent, in discussions or use case studies and videos. This suggests the presence of basic forms of interactive didactics, but without their systematic use. It can be assumed that the members of this cluster functioned in academic environments with a traditional educational model focused on the administered nature of knowledge transfer. The general lack of “frequent” responses (no method exceeds 30%) makes cluster 3 the most passive in terms of teaching profile, which probably reflects conventional teaching models with limited student activity.

Fourth, respondents assigned to Cluster 4 represent a group with a moderate level of work with most of the methods analysed. Characteristic for this group is the declaration of frequent use of activating forms of work, but on a slightly smaller scale than in Cluster 2. The percentage of “often” answers does not exceed 50% in these categories. The most popular form of work in this group was discussions, watching videos and group work, which was declared as “frequent” by about 1/3 of respondents, which may indicate the orientation of the educational institutions they represent towards implementing methods

that support cooperation and communication. Unlike cluster 1, where group work dominates, or cluster 3, where it is almost absent, the values of cluster 4 are more evenly distributed, suggesting a flexible but not deeply rooted use of activation methods.

Table 1. The percentage of "often" responses within experienced methods by cluster

Cluster 1	% of often	Cluster 2	% of often	Cluster 3	% of often	Cluster 4	% of often
Group work	99%	Watching videos	89%	Watching videos	28%	Discussions	47%
Watching videos	68%	Joint assessment of other students' work	88%	Case studies	21%	Watching videos	37%
Discussions	43%	Discussions	80%	Discussions	19%	Group work	35%
Case studies	26%	Group work	77%	Reading articles	17%	Reading articles	28%
Joint assessment of other students' work	12%	Case studies	67%	Joint assessment of other students' work	12%	Field work	27%
Reading articles	10%	Reading articles	66%	Field work	11%	Case studies	24%
Field work	7%	Making presentations (by students)	40%	Making presentations (by students)	1%	Joint assessment of other students' work	15%
Making presentations (by students)	7%	Field work	37%	Flipped classroom	1%	Flipped classroom	10%
Flipped classroom	1%	Flipped classroom	20%	Group work	0%	Making presentations (by students)	7%

Source: based on our study

Survey respondents overwhelmingly see AI as an opportunity for academic education. A response indicating that AI “offers new opportunities” dominated all four clusters, reaching percentages of 48-56%. This means that regardless of previous educational experience, AI is widely understood as a tool that can enrich the learning process - for example, by automating routine tasks, personalizing educational pathways or facilitating access to sources of knowledge. This general optimism toward AI, however, takes on different faces depending on the characteristics of the clusters. In Cluster 1, where group work and elements of interaction predominated, and there were fewer individual forms of activity (e.g., peer review or presentations), respondents show a balance between enthusiasm and caution. Cluster 2, which is characterized by the highest intensity of contact with active and diverse teaching methods, shows the highest level of enthusiasm for AI - not only is there a dominant belief in the positive possibilities of this technology, but also a relatively high inspirational role of AI is noted. It can be assumed that openness to modern teaching tools correlates with easier adaptation to the technological environment and a more reflective approach to its potential. Cluster 3, which is characterized by little experience with interactive and student-centred work methods, shows more reserved attitudes. Although the perception of AI as a useful technology still prevails, the percentage of critical and neutral responses is higher here. This may indicate a lack of infrastructure or educational practice to foster the constructive use of AI, as well as a lower level of digital competence or fear of automating cognitive processes. An interesting case is Cluster 4, which, despite the diversity of teaching methods, shows a slightly higher proportion of neutral (“does not impact”) responses than other groups. This may indicate a pragmatic approach to the role of AI, treated as a tool that supports, but does not redefine, the educational process. For this group, technological innovation may be seen more as a natural extension of existing practices than as a breakthrough (Fig. 3).

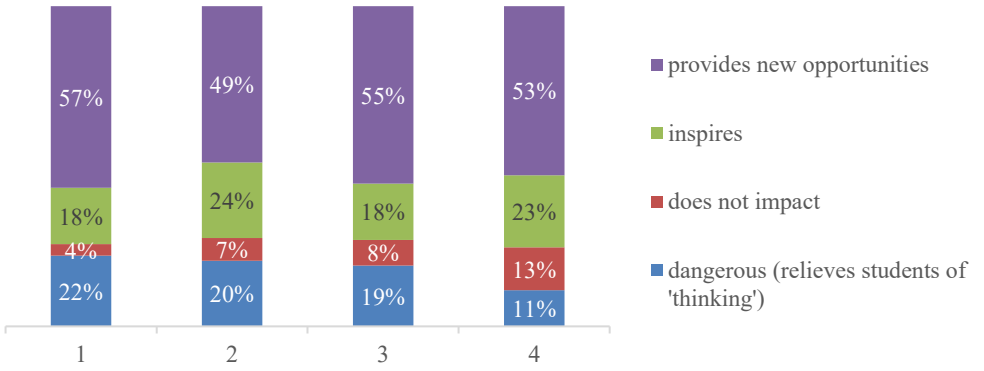

Fig. 3. Perception of the impact of artificial intelligence on studying according to the clusters represented
Source: Based on our study

In all countries analysed, the majority of respondents perceive artificial intelligence as a technology that offers new opportunities in education (Figure 4). The highest percentage of such responses was recorded in Poland (60%) and Greece (55%), slightly lower in Croatia (48%) and Romania (47%). However, the highest scale of critical assessments is noticeable in Croatia: 25% of respondents considered AI a threat to independent thinking, while another 15% said it does not affect studying. This suggests a greater distance from the technology. Greece stands out for having the lowest level of critical attitudes and the highest share of "inspires" responses (21%), which may indicate a more informed and open attitude toward AI. In Romania, an even distribution of positive evaluations is evident, with a strong emphasis on "inspires" (30%). In Poland, responses "inspires" and "does not influence" are less frequent, which may indicate that AI is treated as a practical tool.

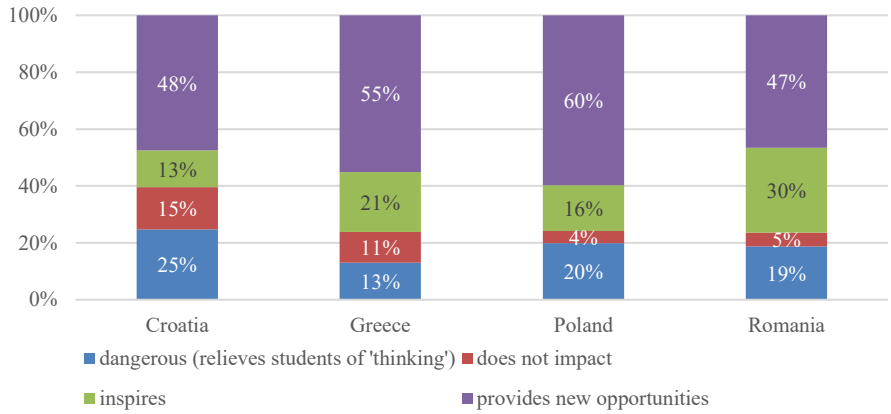

Fig. 4. Perceptions of the impact of artificial intelligence on studying by respondent's country of origin
Source: Based on our study.

4. Conclusions

The results of the implemented survey highlight a clear differentiation between the groups of students, identified by cluster analysis, both in terms of the teaching methods used and attitudes towards artificial intelligence. Students representing cluster 2, accounting for 18% of the total surveyed population, represent the group using the most extensive range of activation methods in the educational process. Students from clusters 1 and 4 selectively use the discussed methods. Only representatives of cluster 3 show a relatively low level of exposure to active methods of knowledge perception.

In each of the analysed countries, respondents mostly perceived artificial intelligence as a technology offering new opportunities in education, especially in Poland and Greece. However, national differences were also evident: in Greece and Romania, responses indicating inspiration from AI dominated, while in Croatia, more people expressed concern about the impact of AI in the education process on independent thinking among students.

The results of the survey confirm that students' attitudes toward AI are strongly influenced

by their experiences with varied teaching methods. Where active, participatory and reflective teaching methods are used, students are more likely to see AI as a tool that not only supports learning, but also develops them. Although the number of methods and tools as well as the intensity of their use varies from cluster to cluster, it can be said that a generational shift is taking place (each generation as a group has different social, educational conditions and personal attributes [10]) in terms of approaches to modern methods and tools supporting the teaching process. The importance of experiential learning approaches is irreplaceable [13] - with the rapid advancement of technology, it is crucial that students know the skills and knowledge they need to succeed in a future dominated by technology [3].

These conclusions point to the need to incorporate diverse didactic methods into curricula to support the development of competencies of the future and openness to new educational technologies. Their application directly translates into the process of building and expanding competencies of the future, including soft competencies such as communication, teamwork and self-presentation. Therefore, universities should not only diversify their approach to teaching, but also monitor students' readiness to use new technologies, ensuring consistency between the curriculum and the changing digital reality. This finding should be a recommendation to redefine the way of transmitting knowledge, primarily taking into account the development of technologies. Not being aware of this fact may translate into a decrease in the level of knowledge perception.

5. Limitations

The authors are aware that the deliberate selection of countries affects the generalizability of the results. However, the aim was not to represent the whole of Europe, but rather to examine contrasts within a region undergoing similar structural and technological changes; they also acknowledge a potential self-selection bias among students more interested in technology or education. The differences observed between clusters and countries may partly reflect national policies, academic culture, and the maturity of digital infrastructure, factors that could be the subject of further research with a broader geographical scope.

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