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AI Opens Up Variability in Education

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Abstract *The article is oriented on opportunities affecting the variability and quality of teaching in computer science subjects, focusing on databases and data warehouses. Artificial Intelligence (AI) is an accelerator of innovation from both the student and the teacher's perspective. It is not just about copying assignments to prompts for AI, but about learning to work effectively with available tools and creating conditions for further development of skills and abilities. Simplification of information availability is evident in the design and creation of databases. Advanced knowledge is manifested in the understanding of the activities performed and critical thinking, which leads to the analysis and selection of appropriate solution options with regard to learning outcomes. Positive benefits are brought by interactive tools such as questionnaires, think-pair-share tasks, and live online questions. A significant moment was the mutual learning of students in discussion and the support of their business plans.*

1. INTRODUCTION

The integration of artificial intelligence (AI) into education (Abdullahi et al., 2026) is significantly transforming many educational activities and management training (Dissanayake et al., 2025). AI technologies have an impact on flexible learning formats (Sobińska et al., 2026), personalized learning, access to resources or intelligent tutoring systems, and lifelong learning (Balta, 2024). For personalized learning, AI enables tailored learning experiences by analyzing individual student data, learning styles, and paces, helping to customize lessons and improve learning outcomes. Access to resources focuses on providing instant access to a large volume of resources, including tutorials, hands-on exercises, and adaptive assessments. Intelligent tutoring systems offer AI-driven tutors who guide students through complex concepts and provide immediate feedback to be closely aligned with student needs and support a more effective learning process (Kuleto et al., 2021). Lifelong learning has a special place here, as AI facilitates continuous learning opportunities for students of all ages to support skills development in a rapidly evolving job market.

This transformation is characterized by pressure on the essential data quality (Vijaya et al., 2025), many challenges and opportunities (Doğan et al., 2024; Zawacki-Richter et al., 2019), and adaptive learning directions. Data quality is required for systematic analysis and classification to ensure the accuracy of the education process. A systematic approach is, in many cases, proposed in a multiple constraints model (Du, 2021). Special machine learning algorithms can dynamically adapt to changes in data patterns, and the primary concern is data integrity and reduced processing time (Islam, 2024). Personalized learning experiences enabling adaptive learning directions have been shown to increase student engagement by 27% (Nangunori, 2024). The primary interest is real-time data analysis to provide timely interventions to improve learning outcomes.

Many benefits may be seen, but challenges such as standardization, privacy worries, and AI ethics requirements are also identified that need to be addressed to ensure effective implementation in

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education (Ayala Ala, 2024). Interest is focused on adapting educational content and methodologies to individual student needs. AI very quickly analyzes student performance and their learning styles to adapt educational content. It is easy to provide dynamic adjustments to teaching materials, and intelligent tutors provide examples of tools that facilitate this personalized approach (Menezes et al., 2025). In this situation, personalized feedback is very important to show individual student progress, and based on the teacher may decide on about next steps to support the learning experience (Barrera Castro et al., 2024).

From a practical perspective, this article focuses on student creativity and collaboration in selected courses focused on database and data warehouses. This is one of many courses for students of the Bachelor's degree program in Management Informatics. Students are young people, around 20 years old (Generation Z). For practice, it is important to support the interests and skills of students, to provide resources that support innovative thinking and collaboration among them and other participants (Hasibuan & Azizah, 2023). IT (Information Technology) development is very fast, changes are very dynamic, new methods and approaches are being developed, so the ability to adapt and solve new, often unexpected situations, is a critical issue. For successful IT implementation (Menezes et al., 2025), critical 21st-century skills need to be developed (Merino-Campos, 2025), including databases and data warehouses.

2. METHODS AND DATA

The second part of this article is devoted to practical forms of education in a selected course (Databases and Data Warehouses) and the method used. For this article, a literature search and interactive activities with students were conducted with subsequent evaluation in terms of learning outcomes. Similar studies often use mixed methods to assess learning outcomes. It is important to monitor students' feedback on the educational process in real time and their role in personalizing the experience. It emphasizes the automation of repetitive tasks for a greater focus on professional development (Tariq, 2025; Iman et al., 2024). In many cases, literature searches from multiple scientific databases and various online sources are used to obtain further information about personalized learning (Hasibuan & Azizah, 2023).

Within the Databases and Data Warehouses course, meetings with students take place every week in the form of standard lectures and seminars. The main emphasis is placed on practical work, there are examples from practice, case studies, questionnaires, think-pair-share tasks and a space for immediate online questions without the need to log in, so it is possible to ask a question without identifying the questioner. Some students prefer this type of communication because they have bad experience in their previous studies. A special place is given to the detailed learning outcomes. For example, the learning outcomes for the course Databases and Data Warehouses are specified as: the student can demonstrate practical knowledge of database management with an extension to data warehouses. Specifically, he/she will explain the meaning of databases, DBMS and formulate requirements for database processing. He/she actively proposes a database creation procedure and specifies the degree of variability for practical use on a model example. He/she characterizes the properties of relational tables, distinguishes between different keys of a relation (table) and relationships between tables. From a practical point of view, he/she specifies requirements for integrity, normalization and practices the syntax of selected SQL commands. He/she also combines automation options, designs and complements implementation variants for model examples in a selected database environment. He/she identifies data warehouse sources, dimensional and factual tables, ETL processes, practically plans advanced analytics and OLAP analyses.

Questionnaires are used very often, in almost all seminars. It is necessary to know the real opinion of students on the topic being discussed. The situation varies depending on the group and the topic. Examples of questions are given in Table 1.

Table 1. Questions for students to learn more about their preferences and expectations

Course	Questions
Databases and Data Warehouses	• What do databases mean for businesses and why do we deal with them? • What bothers you when searching for information? Are databases responsible for this? • What topic do you think the course focuses on? • What database do you have experience with? • What topic would you like to address in the course? • In your opinion, are databases complex? • What influences the choice of database designer or database? • Do the tables (relations) have defined attributes (columns)? List some of them for the selected table that you will include in your answer. What data type are they assigned to? • What skills are needed to solve the above questions? • Which skill would you recommend supporting more?

Source: Own processing

Think-pair-share tasks are designed for an interactive teaching strategy that aims to encourage student participation, critical thinking, and collaborative learning. This is a proven method whose importance (Raba, 2017) is in promoting active engagement and participation. It builds communication and social skills and allows students to process information more deeply through peer discussion. It provides teachers with opportunities for formative assessment to assess student understanding. The process is divided into three steps:

Step 1: THINK - think (4-5 minutes) about the task.
The task specification is related to the chosen topic, for example: What are the available options for communicating with the database? What is your experience with them?.

Step 2: PAIR - discuss with a colleague (4-5 minutes). Divide into groups (pairs, trios, etc.) and share your answer. Compare opinions and find similarities or differences, if any.

Step 3: SHARE - share in the group (5 minutes) using onlinequestions.org. Subgroups share their answer in order to summarize similarities/differences in opinions on the topic.

The site for online questions without the need for login is supported by onlinequestions.org (Live online mode, 2025), see Figure 1. Onlinequestions.org is a website that allows online communication by event number. Students may choose a color and write an opinion, answer or question according to their preference. There is a possibility to select a favorite message using the star symbol (*).

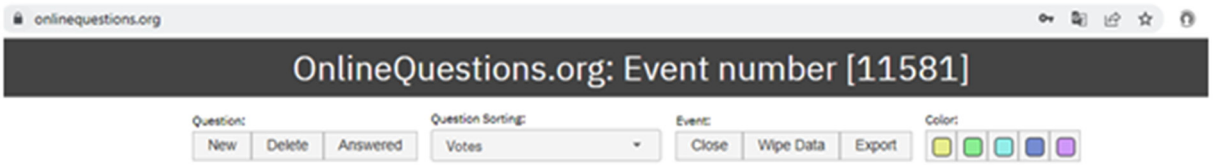

Figure 1. The onlinequestions.org environment for communicating with students

Source: Own processing

The reason for integrating interactive activities into student learning is that they enrich teaching, making lessons more interesting and motivating. By participating in tasks, discussions, and collaborative projects, students develop a deeper understanding of the topic and improve their critical thinking and problem-solving skills. These activities also take advantage of teamwork, helping students learn from each other and develop social skills.

3. RESULTS

This part is devoted to the results and experiences with such education. First of all, it is the ability to introduce a challenge into the learning process. Students try to solve various tasks focused on monitoring variability in database systems, where database software offers approximately 300 products (Best Database Software, 2025). Practical examples focus on Tabidoo, SQLite, MySQL, and Oracle rules for design a database. At the beginning, database patterns and their designs are based on templates. Advanced tasks are focused on the independent creation of a database design and its subsequent creation to support a business according to students' ideas. Selected business plans include creating a database for registering customers in a gym, a reservation system in a hair salon, video game management with monitoring of players' gaming time, or managing a company car fleet. Some students enjoy exploring databases of their own choice with AI support, such as MariaDB. Based on the answers from the questionnaires, it is clear that students correctly understand the meaning of databases and their significance. They associate better data security with greater transparency and a suitable user interface. They do not like SQL commands and confusing search algorithms when processing databases.

Students associate the advantages of databases with speed, reliability, appropriate organization of data, timeliness, and accessibility. When asked What topic would you like to address in the course? they answered that primary keys, queries, relationships, and database design. Students are relatively well-versed in tables, attributes and relationships. They value logic as an essential skill in database design and the creation of databases. Each student works at their own pace, and working in groups is preferred, where discussions take place to select the appropriate solution. Results are presented using questionnaires or onlinequestions.org.

4. FUTURE RESEARCH DIRECTIONS

Currently, selected activities focused on questionnaires, think-pair-share tasks, online questions, and default examples from practice or case study are used in lectures. Information technology has the power to support a wide range of interactions for brainstorming, educational games, group discussions, mind maps, outdoor learning, and role-playing. Question for the future, it is the practical integration of other options for interactive communications in the educational process to make it more attractive. The advantage is evident in the variability that each student may choose according to their preferences.

Teaching enriched with educational games and outdoor learning has promising benefits. Educational games (Stohs, 2022) use the idea that students participate in gamified activities that reinforce concepts through competition and collaboration. This approach increases motivation, engagement, and active learning. Games can be digital or physical, adapted to different subjects. They promote problem-solving and strategic thinking. Outdoor learning (Ennis, 2025) is based on students discovering the real world in the context of their studies. This approach allows for experiential learning that makes abstract concepts tangible. It promotes curiosity, observation, and the application of knowledge outside the classroom.

5. CONCLUSION

The aim of this article is to ensure a better learning process in a course dedicated to databases and data warehouses. This is a rich topic with practical implications for the correct processing of data stored in databases. An adequate literature review was carried out, and references come from

journals, conferences, and websites. Learning methods and data are linked to practical activities in the selected course Database and Data Warehouse. Case studies, questionnaires, think-pair-share tasks, and a place for instant online questions are used to better support students' practical work. The main emphasis is placed on interactive activities with real-time feedback to learn more about students' actual thinking and skills. Respect for individual approach and interest in work in groups to refine communication skills are essential. Future research directions are linked on educational games and outdoor learning.

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