Students and Traditions in Mathematics Education

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Abstract: In higher education, including mathematics teaching, we face new challenges continuously, which are partly due to the changes in the educational environment and partly due to the changes brought about by technology. During the last few years, the pandemic changed many traits of teaching; some solutions developed for those times have now become part of everyday education. At the same time, disruptive methods have been developed, while the traditional ones are still there. Another challenge we face is the validation of knowledge acquired at other institutions during student transfers, partly due to different curricula, course structures, and credit systems. Recently artificial intelligence has opened new dimensions and raised basic questions related to the future of education. In the present paper, we discuss some actual problems of mathematics teaching, with special interest in the coexistence of new and traditional elements.

Keywords: higher education; mathematics; student success

1 Introduction

The saying ‘the devil is in the details’ draws attention to the fact that any plan, concept, or promise only seems simple until one begins to deal with the specifics. Although everything may appear clear at first glance, when it comes to practical implementation, seemingly minor difficulties often emerge—difficulties that can ultimately halt the entire endeavour [1]. A similar phenomenon can be observed in the widely studied process of teaching and learning, whether approached in general terms or in relation to specific domains. When examining the teaching of mathematics, the question of the importance of details cannot be avoided.

Mathematics is often seen by public opinion as a particularly difficult, abstract field of science that requires considerable effort. As a consequence, there is a commonplace conviction that educators must seize every possible pedagogical

tool to bring closer mathematical thinking and the understanding of related notions to students. However, teaching mathematics at the university level places unique challenges before the instructor: the complexity and level of abstraction of the material increasingly limit the possibility of relying on intuitive and illustrative approaches [2].

In higher-level mathematics education, special attention has to be given to the consistent structuring of course content that spans several semesters. The interdependence of mathematical contents and clarity of terminology and notation are the grounds on which successful construction of knowledge in students takes place. This is so important because in mathematics, terms and notation are not always used uniformly; different conventions have evolved in different parts of the world and within different schools of mathematics [3]. Such disparities occasionally create problems for the integration of course content, especially when studying in an international environment or if the instructor uses elements from several sources [4].

Addressing these challenges requires deliberate pedagogical planning, didactic sensitivity, and a deep understanding of mathematical traditions.

Besides all that, it is necessary to underline that the learning process depends not only on tutors' efforts but also on students themselves [5], who try to use every opportunity for widening their knowledge and making the learning process easier [6, 7]. In the context of contemporary higher education, this already includes, to a large extent, the area of digital technologies, which form part of learning strategies [8, 9]. Nowadays, AI is playing an important role in this respect, helping many students significantly in mastering theoretical material, structuring knowledge, and forming problem-solving skills [10, 11].

Thus, the idea of AI-based tools might be attractive to students for several reasons: they could provide quick, immediate, and personalized feedback; they may offer alternative explanations for information that was difficult to understand; or they may aid in processing and structuring large amounts of information. A more specialized math use can involve demonstrating steps to solve a problem in detail, or showing multiple ways to complete the same task [12].

Meanwhile, it should not be forgotten that the use of AI may also imply the emergence of novel types of learning difficulties. It is possible for students to become overly dependent on this type of tool, at the expense of marginalizing their own way of solving problems. Only then does AI truly become a supporting tool in the learning process-when students use its solution critically, consciously, and reflectively [13].

2 Methodology

The questions that formed the base for our questionnaire research were about university students' experiences of the application of AI in education and what advantages and disadvantages they see in the use of AI in the fall of 2025. The current study investigates university students' attitudes and behaviors regarding the use of artificial intelligence in learning contexts. Two important foci were determined as follows: (1) to what extent do students use AI tools in studying, and (2) how much do students trust answers generated by AI. Based on these themes, the following are relevant research questions and hypotheses.

Research Questions

1. To what extent do university students integrate AI tools into their learning activities?

2. How do the students think about the correctness of AI-generated responses?

Hypotheses

• H1: University students actively use AI tools to support their learning processes.

• H2: Students are displaying low levels of trust in AI-produced answers being correct.

In line with the ethical standards of applied research, participation in the collection of data by questionnaire was voluntary. Before the survey started, clear information on the purpose of the study was communicated to the respondents, together with information on the content of the questionnaire, including the free choice of participation and the possibility at any time to discontinue it, including refusal or withdrawal without negative consequences. It was also pointed out that no personal data were collected within the scope of the research and that responses could not be attributed to the respective respondents in any manner, which meant full anonymity and protection of data. The questionnaire was made available online in the autumn of 2025, enabling wide-ranging, barrier-free access, without collecting any technical data that could identify the participants. The whole process of research was performed in accordance with ethical standards for social science data collection, particularly emphasizing transparency, anonymity, and voluntariness.

3 Results

Grassini AI Attitude Scale (AIAS) is a short questionnaire developed in 2023, which consists of only four items intended to measure individuals' general attitudes toward artificial intelligence [14]. Empirical evidence suggests that the

AIAS exhibits strong internal reliability, providing an effective tool for the swift and reliable assessment of attitudes toward AI across different populations. Respondents grade each statement on a Likert scale, with higher scores reflecting a more positive disposition toward AI. In our present study, we have used this scale to investigate the attitude of our students. The results are shown in Figure 1.

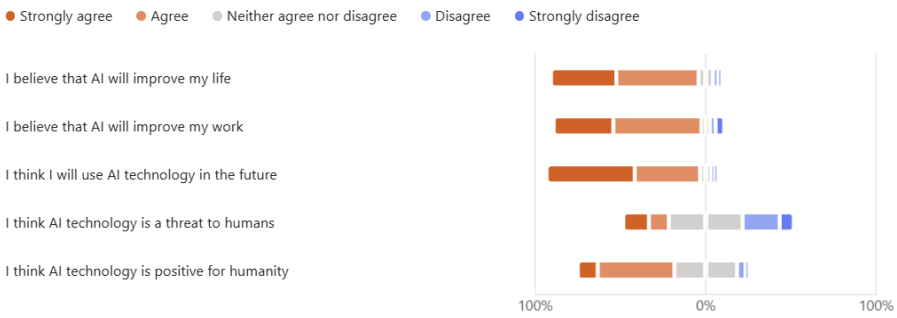

Figure 1

University student's attitude towards AI using Grassini AI attitude scale

Based on the data presented in this chart, the main concerns related to AI use in education become clearly visible. The responses fall into four categories, and their proportions give important insight into which areas need special attention in the future.

The biggest share of concerns deals with data privacy. This shows that among the respondents, of primary concern is the assurance that personal information about students, learning progress, or digital footprints do not fall into unauthorized hands. In most instances, AI systems require the collection and processing of data; hence, participants strongly feel that in the absence of proper safety measures and laws governing data handling, the implementation of AI might be risky.

The second most frequent category deals with the ethical problems of the studied phenomenon. These may vary from possible biases in algorithms through the transparency of the AI decision-making to fair treatment with regard to students. These ethical concerns signal that with the implementation of AI systems, it is not sufficient to consider purely technical and pedagogical aspects, but also ethical guidelines and responsibility frameworks.

Nearly a quarter of the respondents fear that AI may push the role of teachers into the background. This is a concern that seems to suggest many remain uncertain as to how AI can complement teaching without seeking to replace it. Hence, the key challenge will be a clear communication that AI is not here to substitute for teachers but is here to support learning, enable differentiation, and reduce administrative burdens.

Although the “Other” category proportion is relatively small, it has to be underlined that respondents mentioned other, smaller-scale concerns, referring to technical, infrastructural, motivational, or pedagogical problems.

Figure 2

Students’ concerns about using artificial intelligence in education

The diagram shows that the majority of the respondents consider the information and assistance provided by AI to be reliable or very reliable. The “Reliable” and “Very reliable” categories together clearly dominate, suggesting that participants generally have positive experiences with using AI-based systems.

The middle of the scale contains a moderate proportion of "Neutral" responses, showing that a smaller group is neither positive nor negative about AI reliability, or perhaps has not yet formed a strong enough opinion.

The categories "Slightly reliable" and especially "Not reliable at all" are low in proportion. This indicates that only a few respondents feel there is something specifically negative or are concerned that AI gives them wrong, misleading, or incorrect information.

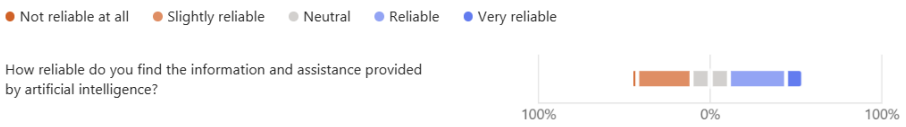

Figure 3

Students’ concerns about reliability of artificial intelligence

A qualitative analysis of 50 student responses on appropriate forms of AI in university courses shows a number of emergent themes. The dominant theme was that of personalized learning, represented in 56% of the responses. They stressed that AI could adapt learning content to students' needs, explain complex topics, and serve exam preparation (e.g., mock tests, summaries).

Chatbots and automatic grading were second most frequent, both mentioned by 14% of respondents. The benefit of chatbots was seen as continuous support provided, answering students' inquiries continuously. Automatic grading was viewed as a method to enhance efficiency, freeing faculty from more mundane duties.

Other key themes that came up included learning support functions, such as note-taking, summarizing, and virtual tutor roles, at 12%, and information search at 10%, where AI was described as a superior alternative to traditional search engines for academic research and problem-solving.

A minority (2%) expressed a critical opinion, stating that AI should ideally not replace human educators and warning against cost-driven decisions in education. Another 4% proposed creative applications: adaptive testing and traffic analytics.

Findings show that students see AI as a tool to improve personalized learning experiences and administrative workflows; some few raise concerns about its larger effects on educational quality and equity.

Table 1

Use of Artificial Intelligence in Higher Education according to Students

Theme	Example	Frequency	Percentage
Personalized learning	Personalized learning and making summaries	28	56.00%
Chatbots	chatbots based on teacher's upgraded materials	7	14.00%
Automatic grading	automated grading and correction exams	7	14.00%
Information search	AI acts like a better version of googling	5	10.00%
Learning support	creating notes, virtual tutor	6	12.00%
Critical stance	Ideally, none at all	1	2.00%
Other innovative ideas	Traffic Analytics, Adaptive Testing	2	4.00%

During the semester students were introduced several examples that highlight how important is to critically examine the data and outputs provided by AI.

In the following example, we asked an AI bot to plot the vector field (-y; x). The result, shown in Figure 4 on the left, is clearly unacceptable. Contrary, the correct answer also introduced in Fig. 4 on the right. Similarly, in the context of complex function theory, verifying the Cauchy–Riemann equations also proved problematic, as illustrated in Figure 5.

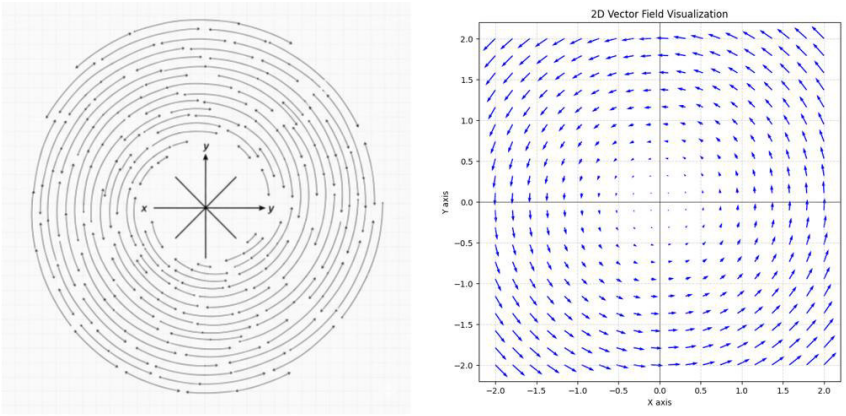

Figure 4
Vector field by AI and a computer algebra system

2. $f(z) = z^3$

Let $z = x + iy$. Then:

$$f(z) = (x + iy)^3 = x^3 - 3xy^2 + i(3x^2y - y^3)$$

So:

$$u(x, y) = x^3 - 3xy^2, \quad v(x, y) = 3x^2y - y^3$$

Cauchy-Riemann Equations:

$$\frac{\partial u}{\partial x} = 3x^2 - 3y^2, \quad \frac{\partial v}{\partial y} = 3x^2 - 3y^2$$

$$\frac{\partial u}{\partial y} = -6xy, \quad \frac{\partial v}{\partial x} = -6xy$$

Thus, the equations are satisfied.

Figure 5
Cauchy-Riemann – equations calculated by AI

4 Discussion and conclusions

Our results confirm hypothesis H1, whereas H2 clearly needs to be rejected. It can be clearly concluded from the responses that the student group investigated actively uses artificial intelligence to a great extent, and the majority considers its

use for learning purposes to be adequate. This would suggest that AI tools have already become part of everyday learning processes and that the majority of students consider these technologies as useful resources to support their learning. At the same time, examples presented in the paper also show that solutions given by AI are often doubtful, incorrect, or pedagogically problematic. These findings hint that the use of AI in education opens up new chances but at the same time poses new problems [15, 16]. The reliability of contents generated by AI, the necessity of critical interpretation, and the change of learner autonomy and the teacher's role are only a few questions that demand detailed consideration. Such complex problems need further empirical research, which may contribute to establishing the foundation for the responsible and effective implementation of AI in education.

One of the main areas for development in students is not the instinctive acceptance of ready-made solutions, but rather the ability to weigh those solutions from a critical point of view [17]. That includes, among others, being aware of the fact that not every answer provided by AI is accurate, complete, or interpretable in the correct context. Critical thinking supports them in recognizing possible mistakes, biases, or logical deficiencies and in seeking alternative solutions when necessary. The strengthening of this skill will assure in a long-term perspective that students will apply AI tools consciously, reflectively, and responsibly in their studies and further professional activities.

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