THE USE OF ARTIFICIAL INTELLIGENCE BY STUDENTS OF INFORMATION TECHNOLOGY PROGRAMMES

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Abstract
The use of artificial intelligence (AI) tools in university education is a phenomenon of various directions: the potential of AI tools, skills, purpose and sense of usage. Each direction is worth of working out and introducing regulatory systems and deeper investigating users' choice and managing the process of getting, navigating and creating information by means of AI. Therefore, one of the emerging scientific challenges is students' abilities and personalised learning experience in the use of AI. The study is focused on the usage of AI in specific courses, and namely the students of Information Technology (IT) programmes from Latvia University of Life Sciences and Technologies (LBTU) and Riga Technical University (RTU). The aim of the study is to investigate the students' ability, need and merit to use AI in learning numerical methods, mathematics and programming. The main data collection method used is a student survey. According to the main results, it is found out that respondents when solving the programming tasks sometimes used AI, while solving mathematical tasks respondents rarely used AI. AI actually did not help to solve the mathematical tasks, while it partly helped to solve the programming tasks. The use of AI partly helped the respondents to improve the knowledge and skills of programming. Acquiring the study course Numerical Methods respondents mainly used ChatGPT, but performing practical works respondents mostly did not use AI.
Key words: artificial intelligence (AI), university, IT students, numerical methods, mathematics, programming.

Introduction

Nowadays artificial intelligence (AI) is a dynamically developing concept and it contains multi-sided usage from the point of view of its opportunities. Therefore, it is necessary to explain how, what for and why the definite AI is used.

The increasing usage of AI and its scope and potential is explicitly topical but this process keeps also high necessity of developing new learning skills and regulatory systems. UNESCO has published several documents on AI usage particularly in education because the access to AI and appropriate policy making is becoming an essential challenge to students and governing authorities (UNESCO, 2023a). UNESCO claims educational institutions 'to validate GenAI systems on their ethical and pedagogical appropriateness for education' (UNESCO, 2023b). Therefore, common understanding of AI is crucial in the development of further policy and solutions, and UNESCO defines that 'Generative AI (GenAI) is an artificial intelligence (AI) technology that automatically generates content in response to prompts written in natural – language conversational interfaces' (UNESCO, 2023b).

However, Organisation for Economic Co-operation and Development (OECD) defines that 'Artificial intelligence system: a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations or decisions that can influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment' (OECD. AI Policy Observatory, 2023).

The usage of AI causes numerous challenges as 'fragmentation, vague definitions, guardrail ambiguity and model access', and there is analysis what 'safe generative AI models' mean in the frame of 'current AI landscape' (AI Governance Alliance, 2024).

By OECD, AI is considered from five crucial valued-based principles. In the rationale of the inclusive growth, sustainable development and well-being the principle of supportive and AI promoting attitude is emphasized in relation to 'social good' and 'to achieving the Sustainable Development Goals (SDGs) in areas such as education, health, transport, agriculture, environment, and sustainable cities, among others' (OECD. AI Policy Observatory, 2023).

The use of AI in university learning environments is developing depending on the nature of assignments and obtained course. Students try to use AI creatively to reach better learning results. This process should be promoted also in the interaction with teachers and tutors helping to comprehend and improve smart, transparent, safe and ethical usage of AI.

The scope of scientific problems in the field of AI research is wide covering privacy, fairness, critical thinking, academic integrity, quality and reliability of AI generated content, access of AI, mental health, personalised experience, ethics, teaching and research quality, adaptation to AI, and changes in teaching/learning process issues. That is why the particular investigation on the usage of AI in students' learning is focused on their personal experiences and has been carried out at Latvia University of Life Sciences and Technologies (LBTU) and Riga Technical University (RTU), and it outlines the problems and successes of the process.

The aim of the study is to investigate the students' ability, need and merit to use AI in learning numerical methods, mathematics and programming.

Materials and Methods

The study has been carried out during the autumn semester of 2023 by means of the survey, and 187 students of Information Technology programmes from LBTU and RTU participated. The total number of students who were approached to participate in the survey is around 500, consequently, 37% of students expressed their opinion.

Both higher education institutions have similar background because there are IT programmes and students study the courses of numerical methods, mathematics and programming. This background is chosen also for the reason that all three courses are interconnected and mutually complementing each other. Numerical methods are mathematical methods used to solve problems in various disciplines that use mathematical models. These involve numerical solutions using computational algorithms implemented through computer programming. Students study this course when they have already completed the higher mathematics course and acquired programming skills and abilities.

138 students (74% of the surveyed students) stated that they have used AI tools in the learning process. Therefore, the answers given by these students will be further analysed. Results from nine questions of the survey were used in the study. This group of questions focused on getting information about reasons, merit and frequency of the usage of AI in the study courses of numerical methods, mathematics and programming. Respondents for the study were randomly selected. The online survey took place under the same conditions. The number of questions asked is relatively small, so the probability of the effect of fatigue is small. The survey data is qualitative, so non-parametric statistics, in this case the chi-square test, were used to process the data (Gunarto, 2019).

The frequency of respondent answers (for all questions) was statistically analysed using chi-square test (Tables 1-9). The following hypotheses were tested for further data analysis:

H_0: the frequency of the answers is the same;

H_1: the frequency of respondent answers differs significantly.

The data were analysed statistically by using SPSS software.

Results and Discussion

Two survey questions were about using of AI tools to solve either a mathematical or programming task ('How often do you use AI tools to solve a mathematical or programming task?')

'Figure 1' shows that for solving the programming tasks respondents sometimes used AI (57 or 41%), while for solving the mathematical tasks respondents rarely used AI (58 or 42%). AI is able to write a code, optimize the existing code or to point to possible problems. This is why respondents used AI in the tasks of programming.

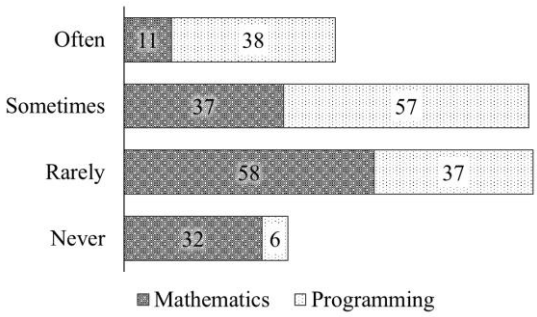

Figure 1. Usage of AI tools to solve a mathematical or programming task (N=138).

The frequency of respondents' answers about the use of AI tools for solving both mathematical and programming task was statistically analysed in Table 1 and 2.

Table 1

Chi-square test statistics of frequency of AI tools usage to solve a mathematical task

	Observed N	Expected N	Residual
Often	11	34.5	-23.5
Sometimes	37	34.5	2.5
Rarely	58	34.5	23.5
Never	32	34.5	-2.5
Total	138		
Chi-Square	32.377		
df	3		
Asymp.Sig.	0.000		

Since the p-value of 0.000 is below the significance level of $\alpha = 0.05$, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers and the answer 'Rarely' being statistically significant. According to the authors' experience, in mathematics courses, students most often use AI tools to understand how to complete a task step-by-step. At the same time, students note that when trying to solve problems from different mathematics courses, a different and not always correct solution is offered every time, so AI tools are rarely used for solving mathematical problems.

Table 2

Chi-square test statistics of frequency of AI tools usage to solve a programming task

	Observed N	Expected N	Residual
Often	38	34.5	3.5
Sometimes	57	34.5	22.5
Rarely	37	34.5	2.5
Never	6	34.5	-28.5
Total	138		
Chi-Square	38.754		
df	3		
Asymp.Sig.	0.000		

Since the p-value = 0.000 is less than the significance level of α = 0.05, the null hypothesis can be rejected. Thus, it can be concluded that the frequency of respondent answers is different. Statistically significant prevalence was observed in the answer 'Sometimes'. According to the authors' experience, students most often use AI tools to quickly identify errors in programming code, optimize it, and understand how operators function.

Two other survey questions focused on whether AI helped to solve a mathematical or programming task ('Did AI help with mathematical or programming task?') 'Figure 2' illustrates that AI actually did not help in solving mathematical tasks (48 or 35%), while it partly helped to solve programming tasks of (56 or 41%). This can be explained as AI can provide answers in the most popular languages of programming and help with scripts, but mathematical tasks are unique.

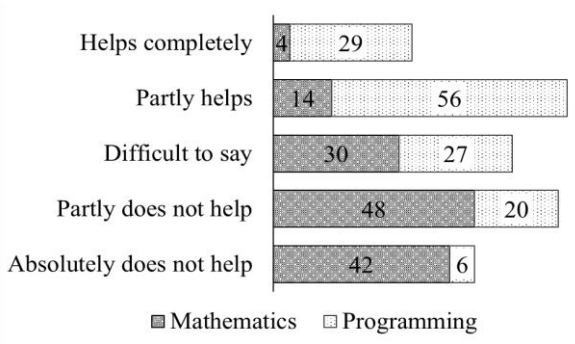

Figure 2. AI helped to solve a mathematical or programming task (N=138).

The answers to mathematical (Table 3) and programming (Table 4) tasks were analysed separately using Chi-square test below.

Table 3

Chi-square test statistics for whether AI helped solve a mathematical task

	Observed N	Expected N	Residual
Helps completely	4	27.6	-23.6
Partly helps	14	27.6	-13.6
Difficult to say	30	27.6	2.4
Partly does not help	48	27.6	20.4
Absolutely does not help	42	27.6	14.4
Total	138		
Chi-Square	49.681		
df	4		
Asymp.Sig.	0.000		

Since the p-value of 0.000 is below the significance level of α = 0.05, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers and the answer 'Partly not helps' being statistically significant.

Table 4

Chi-square test statistics for whether AI helped solve a programming task

	Observed N	Expected N	Residual
Helps completely	29	27.6	1.4
Partly helps	56	27.6	28.4
Difficult to say	27	27.6	-0.6
Partly does not help	20	27.6	-7.6
Absolutely does not help	6	27.6	-21.6
Total	138		
Chi-Square	48.304		
df	4		
Asymp.Sig.	0.000		

Since the p-value of 0.000 is below the significance level of α = 0.05, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers and the answer 'Partly helps' being statistically significant.

Two other survey questions focused on improving mathematical or programming knowledge and skills using AI ('Does using AI help you improve your programming knowledge and skills?')

'Figure 3' shows that respondents had difficulty judging whether AI helped to improve mathematical knowledge and skills (39 or 28%), while using AI partly helped respondents to improve the programming knowledge and skills (59 or 43%).

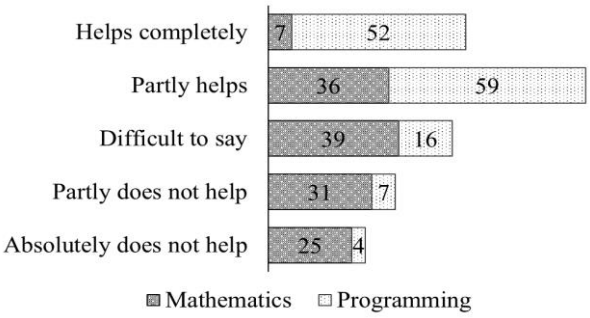

Figure 3. Improving mathematical or programming knowledge and skills using AI (N=138).

The answers to mathematical (Table 5) and programming (Table 6) tasks were analysed separately using Chi-square test below.

Since the p-value of 0.000 is below the significance level of α = 0.05, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers and the answer 'Difficult to say' being statistically significant.

Table 5

Chi-square test statistics about improving mathematical knowledge and skills using AI

	Observed N	Expected N	Residual
Absolutely not helps	25	27.6	-2.6
Partly not helps	31	27.6	3.4
Difficult to say	39	27.6	11.4
Partly helps	36	27.6	8.4
Helps completely	7	27.6	-20.6
Total	138		
Chi-Square	23.304		
df	4		
Asymp.Sig.	0.000		

This response was expected because there are students who admit that they use AI tools to explain a mathematical problem-solving algorithm, while several students believe that an AI tool often gives the wrong solution to a mathematical problem.

Table 6

Chi-square test statistics about improving programming knowledge and skills using AI

	Observed N	Expected N	Residual
Absolutely not helps	4	27.6	-23.6
Partly not helps	7	27.6	-20.6
Difficult to say	16	27.6	-11.6
Partly helps	59	27.6	31.4
Helps completely	52	27.6	24.4
Total	138		
Chi-Square	97.725		
df	4		
Asymp.Sig.	0.000		

Since the p-value of 0.000 is below the significance level of $\alpha = 0.05$, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers and the answer 'Partly helps' being statistically significant. This response was expected, because many students admit using AI tools to understand how programming code works and find errors in their own.

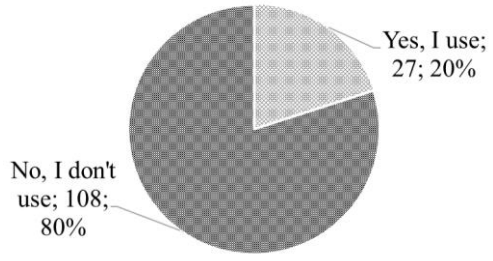

Figure 4. Using AI in course 'Numerical Methods' (N=135).

One survey question was about using AI in the course 'Numerical Methods' ('Did you use AI in the course Numerical Methods?').

'Figure 4' shows that respondents mostly did not use AI acquiring the study course 'Numerical Methods' (108 or 80%).

The frequency of respondent answers (using AI in the course 'Numerical Methods') was statistically analysed in Table 7.

Table 7

Chi-square test statistics of AI tools used in the course 'Numerical Methods'

	Observed N	Expected N	Residual
Yes, I use	27	67.5	-40.5
No, I don't use	108	67.5	40.5
Total	135		
Chi-Square	48.6		
df	1		
Asymp.Sig.	0.000		

Since the p-value of 0.000 is below the significance level of $\alpha = 0.05$, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers, and the answer 'No, I don't use' is statistically significant. Several students indicated that they were provided with good learning materials and therefore they did not need to use AI tools.

One survey question was about the usage of AI for practical works in the course 'Numerical Methods' ('Could you use AI for all practical works in the Numerical Methods course?'). This question was asked because the authors and their colleagues have verified that in some cases the correct answer is obtained by AI, and AI can help with practical tasks.

'Figure 5' shows that respondents acquiring the study course 'Numerical Methods' and performing practical tasks mostly did not use AI (120 or 94%).

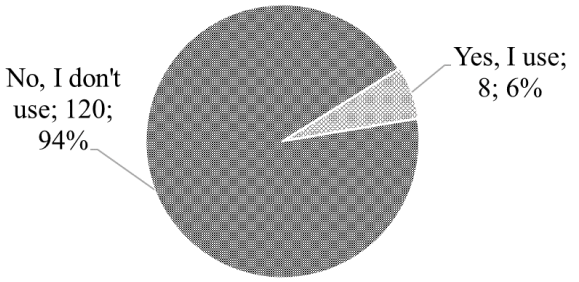

Figure 5. Usage of AI for all practical tasks in course 'Numerical Methods' (N=128).

The frequency of respondents' answers (using AI for all practical works in the course 'Numerical Methods') was statistically analysed in Table 8.

Table 8

Chi-square test statistics of AI tools used for all practical works in the course 'Numerical Methods'

	Observed N	Expected N	Residual
Yes, I use	8	64.0	-56.0
No, I don't use	120	64.0	56.0
Total	128		
Chi-Square	98.000		
Df	1		
Asymp.Sig.	0.000		

Since the p-value of 0.000 is below the significance level of $\alpha = 0.05$, we can reject the null hypothesis. Therefore, it can be concluded that there are differences in the frequency of respondents' answers, and the answer 'No, I don't use' is statistically significant. Only a few students tried to use the AI tools in every practical task, but the students themselves admit that this was because they wanted to challenge themselves and the AI tool and still get the right answer by asking the questions correctly in multiple attempts.

One of the survey questions was about the use of different AI tools in the course 'Numerical Methods' ('Which AI tool did you use for the course Numerical Methods?'). 'Figure 6' shows that respondents mostly used ChatGPT acquiring the study course 'Numerical Methods' (35 or 41%), or did not use AI at all because it does not help (33 or 39%). The other AI tools were used very little – Microsoft Bing was used by 14 or 16% respondents, Google Bard was used only by 3 or 4% respondents.

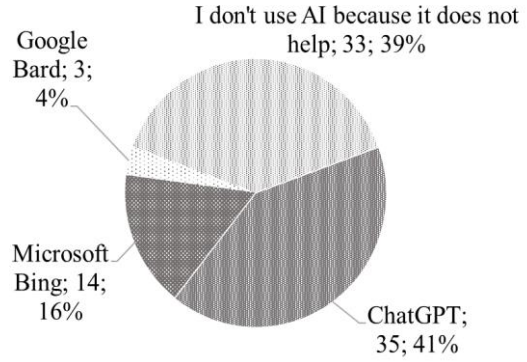

Figure 6. Usage of different AI tools in the course 'Numerical Methods' (N=85).

The frequency of respondents' answers (use of different AI tools in course 'Numerical Methods') was statistically analysed in Table 9.

Since the p-value of 0.000 is below the significance level of $\alpha = 0.05$, we can reject the null hypothesis and conclude that the frequency of respondent answers is different. Statistically significant prevalence was the answer ChatGPT.

Table 9

Chi-square test statistics of different AI tools used in the course 'Numerical Methods'

	Observed N	Expected N	Residual
ChatGPT	34	17.0	17.0
Bing	14	17.0	-3.0
Chat	1	17.0	-16.0
Google Bard	3	17.0	-14.0
Other	33	17.0	16
Total	85		
Chi-Square	59.176		
df	4		
Asymp.Sig.	0.000		

The use of AI in learning process is in line with the choice of AI-generated content assessing it critically and using appropriately in a particular context. Students have to assess their needs, merit and challenges including capabilities and limitations using AI. There is a risk of limited or even incorrect information. Hence, understanding the necessity of meeting the needs of critical thinking, continuous development of skills of using AI and adapting to it should be an essential part of students' learning. Of course, AI offers great opportunities to learn, find and choose information, but it is a challenge as well. In this situation, educational institutions also have to adapt and offer integrated themes or courses to promote successful usage of AI for students and academic staff as well. That is why both investigations related to students and academics in the use of AI are vitally important.

So, the impact of Chat GPT and AI has been analysed among academics as well covering the questions about integration of Chat GPT in research and educational work, ethical aspects and its impact on future work (Livberber & Süheyla, 2023).

Students' interest and involvement in learning process also vitally depends on academics' 'attitude to emerging technologies' (McGrath *et al*., 2023), and the use of AI is not an exception. It means that the academics have to change a lot in their practices by means of adapting to rapidly changing AI progress and developing new teaching and mutual co-operation methods to help the students.

LBTU and RTU students' interest on learning and using AI was mainly in the programming tasks and mostly by ChatGPT. It is worth mentioning that in the study by Manuela-Andreea Petrescu, Emilia-Loredana Pop and Tudor-Dan Mihoc about the second year Computer Science students at Babes-Bolyai University in Romania the data on students' interest in learning AI were quite different, and, for example, applicability and innovative aspects of AI were more scored by men than by women (Petrescu, Pop, & Mihoc, 2023).

The study from Hong Kong on a survey results of '399 undergraduate and postgraduate students from various

disciplines' reflects the students positive attitude towards GenAI both in their teaching and learning process, and 'the potential for personalized learning support, writing and brainstorming assistance, and research and analysis capabilities. However, concerns about accuracy, privacy, ethical issues, and the impact on personal development, career prospects, and societal values were also expressed' (Chan & Hu, 2023).

Research at the graduate level has to be increased because of growing AI opportunities and also in the aspects of its advancement (Crompton & Burke, 2023).

The study is devoted to personalised student experience, and contribution of AI could be substantial in personalised learning process. Speaking about the evolution of AI, J. Neill stresses the opportunities to create personalised study plans, adapting to students' learning styles and strengths as well as standardized test preparation (Neill, 2023).

The opportunities of AI are also essential in career development because of offered 'writing tools, subject and career exploration, college selection, resume enhancement, interview preparation, portfolio development and evaluation and study guides or customised test preparation' (Neill, 2023). Students who are serious about their career development should be interested in acquiring AI tools and this direction should be enhanced by academic staff as well to help the students to find out the most appropriate occupation in a wide and multisided field of IT.

There is also an example in the form of a guide providing systemic and practical instructions for teaching AI and particularly ChatGPT (Center for the Advancement of Teaching, 2023).

As the use of ChatGPT has essentially grown in the world, a special attention should be devoted to the potential of this tool (Fütterer *et al*., 2023). The anonymous survey results from more than 6300 students in Germany show 'that almost two-thirds of the students surveyed use or have used AI-based tools as part of their studies. In this context, almost half of the students explicitly mention ChatGPT or GPT-4 as a tool they use. Students of engineering sciences, mathematics and natural sciences use AI-based tools most frequently' (Von Garrel & Mayer, 2023). The survey results from LBTU and RTU also confirm that the tool of ChatGPT is the most popular among IT students.

Kevin Dykema, President of National Council of Teachers of Mathematics, emphasizes that AI could be an essential aid both for students and teachers but it will not replace them, and constant learning about its usage in mathematics is important because integration of AI in teaching/learning process is an indicator of following the development of nowadays technologies (Dykema, 2023). Therefore, more adaptive learning and personalized learning experiences could be developed through AI systems (Sinha, 2023).

The study data from LBTU and RTU is an evidence of problems students meet, and highlights that specific knowledge and skills of the use of AI should be improved by the students themselves and/or by the assistance of academic staff because AI actually is an aid giving a unique opportunity to achieve higher learning outcomes also in quite complicated exact courses.

Conclusions

1. AI has transformational impact on higher education processes and student/academic staff's ability to adapt, assess and use it appropriately and redesign practice to make teaching/learning more effective.
2. Continuous learning and necessity to organise also further education courses or themes integrated in regular courses to be in line with the development of AI is a new challenge for higher education institutions.
3. The use of AI by IT students can impact their personalised learning process and career development, but it is significantly related to their conscience and understanding of AI opportunities.
4. A gap between AI opportunities, the usage skill and ethical and legislation aspects is an indicator of nowadays challenges on the country and institutional level. It means that the development of AI literacy and skills is a complex work depending on willingness to be in line with the progress of knowledge society.
5. With a probability of 95%, it can be concluded that solving the programming tasks, respondents sometimes used AI (p-value = 0.000), while solving the mathematical tasks, respondents rarely used AI (p-value = 0.000). AI actually did not help to solve the mathematical tasks of (p-value = 0.000), while it partly helped to solve the programming tasks (p-value = 0.000). The use of AI helped respondents to partly improve the knowledge and programming skills (p-value = 0.000).
6. When acquiring the study course 'Numerical Methods' respondents mainly used ChatGPT (p-value = 0.000), while performing practical tasks, respondents mostly did not use AI (p-value = 0.000), because it does not help and students are mostly satisfied with the materials offered by the lecturer within the study course.

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