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TEACHING, RESEARCH AND APPLICATION OF ARTIFICIAL INTELLIGENCE AT BELGRADE METROPOLITAN UNIVERSITY

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ABSTRACT

The article states aim and strategy of applying generative AI in education, research and university operations at Belgrade Metropolitan University. A list of 15 AI courses currently being studied at BMU is given. Current R&D activities on use of generative AI in learning materials preparation, students learning, rating of student's assignments, and in management of university operations are listed.

In the discussion section, the challenges of applying Generative AI tools in education are analyzed and possible solutions of these challenges applied to Belgrade Metropolitan University are listed. The three-layer competency model that is now in use at Belgrade Metropolitan University is also shown, which indicates, among other things, the possibility of applying personalized courses or lessons, at the request of a student or employer. Their implementation is effectively carried out through the interaction of Generative AI tools, teachers, students and, possibly, employers. Thus, even on request of a just one student, the competencies of interest to the student and/or the employer can be added, expanded or deepened.

In conclusion, it is stated that it is necessary for students to master the application of Generative AI due to the needs of their future employers, but that their understanding of what the Generative AI offers them must be checked. Generative AI provides efficiency and quality of education, but it is necessary to adapt the regulation to the possibilities of Generative AI application in education.

KEY WORDS

AI in education, AI in high-education, development and evaluation of learning materials using GenAI, AI supported grading of student assignments, AI supported personalization of education

CLASSIFICATION

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INTRODUCTION

Since the Belgrade Metropolitan University (BMU) belongs to the category of integrated private universities in Serbia, which includes four integrated faculties (without the status of a legal entity) and all non-integrated faculties with the status of a legal entity), in this article all information refers only to the integrated part of the university. An integrated part of the university consisting of the following integrated faculties (which do not have the status of a legal entity): Faculty of Information Technologies, Faculty of Management, Faculty of Digital Arts, and Faculty of Foreign Languages [1]. Non-integrated faculties, which are members of the Metropolitan University, offer programs within the framework of economics (FEFA) [2], and of ecology (Futura) [3]. According to the Law on Higher Education of the Republic of Serbia, they have great autonomy in relation to the university, and they decide on many things independently of the university's authorities. That is why the subject of attention in this article is the work of the integrated part of the university,

The aim of this article is to provide an overview of the current educational offer of the university in the field of artificial intelligence, to indicate the challenges of its application in higher education and to indicate the research and development activities of the university in the field of application of artificial intelligence and digital technologies at the university.

This article is the result of research and testing of the application of different approaches and tools of Generative Artificial Intelligence (GenAI) in the preparation of classes in the subject SE201 Introduction to Software Engineering, starting from the end of 2022 until today. When working in this period, the results of relevant research were analysed and used [4-38].

The authors and their collaborators started research in the application of artificial intelligence in the personalization of student learning since 2012, in which machine learning was used for the classification of student profiles, and the expert system for the selection of learning objects in the creation and configuration of teaching material for individual student profiles, while monitoring their learning progress during the semester, generating personalized teaching material in accordance with the learning progress of each student [39-44]. However, with the advent of tools for the application of generative intelligence (from November 2022), the technological focus of these researches has been redirected to the application of GenAI tools in education [45, 46].

OBJECTIVES OF APPLYING ARTIFICIAL INTELLIGENCE AT BMU

Objectives of application at the integrated part of the university:

1.) To prepare students for the application of AI in their workplace.
2.) To enable students to understand how artificial intelligence models work and how to choose them to solve specific problems
3.) Increase the efficiency and quality of studies
4.) By researching the theories of artificial intelligence, enable the solution of more complex requirements and models of artificial intelligence, as well as its effective applications in certain fields of application
5.) Research not only on technical but also on other challenges on the development of artificial intelligence, which include ethical, social and legal aspects of using artificial intelligence.
6.) Internalization of business, which includes offering educational, research and business services to requests from both Serbia and abroad.

STRATEGY FOR ACHIEVING THE OBJECTIVES

Education

1.) In the study programs, continue with the study of artificial intelligence at all three levels of academic studies (basic, master's and doctoral studies), namely:
   - by offering subjects that study all the characteristic methods of artificial intelligence,
   - pay special and greatest attention to generative artificial intelligence and all its application methods and tools,
   - in all subjects, in accordance with their specificities, include the application of AI, especially the methods of GenAI and its application tools,
   - development of methods for evaluating student papers, pre-examination requirements and exams.
2.) For students of the Faculty of Information Technologies, provide subjects that offer students competencies for the development of large machine learning models (LLM) and the theoretical basis of their application in certain areas, and for special purposes.
3.) For students of the Faculty of Management, pay special attention to courses that apply artificial intelligence methods in digital business and digital transformation of organizations.
4.) For students of the Faculty of Digital Arts, analyze the possibilities and limitations in the application of generative intelligence
5.) For students of the Faculty of Foreign Languages, focus special attention on the correct translation of texts using GenAI, as well as the application of appropriate GenAI tools.
6.) Development of methods of personalization and adaptive teaching using methods of GenAI.
7.) Optimization of the educational function in higher education by applying different forms of teaching (classical, synchronous and asynchronous online teaching, flipped classroom teaching, laboratory and practical, etc.), with the application of appropriate pedagogical methods and didactic tools, artificial intelligence, in order to support the creative and active learning of students, guided by the defined competencies that they should acquire both at the level of the subject and at the level of the study program.
8.) Internationalization of university study programs, forms and methods of study adapted to the requirements of students from abroad.

Scientific research

1.) Theoretical research in the field of artificial intelligence that pushes the boundaries of its application.
2.) Research and development of dedicated intelligent systems in various fields of application.
3.) Unification of technological, ethical, sociological and legal aspects in the research and development of intelligent systems.
4.) Research in the field of personalization of education and adaptability of study programs and subjects to the requirements of the education market.

Development and operations of the university

1.) Defining and automating new, integral business processes and their databases at the university with the aim of high efficiency in work, for quick making of quality decisions and providing accurate and precise information to students, teaching staff, and those interested in enrolling in Metropolitan studies at the university (e.g. how to choose and what to study, mentoring of students, full information of students about the status of their studies, etc.).
2.) To carry out a gradual digital transformation of the university with the aim of implementing the digital business of the university, digitizing its educational function, and providing comprehensive support for research conducted at the university.

3.) Application of personalization and adaptability of study programs and subjects, as well as research in accordance with the interests and possibilities of students, teachers and associates, as well as in accordance with the needs and requirements of individual employers.
4.) Perform analyses of all business costs, analysis of the profitability of individual study programs, direction and subjects, financial plans and predictions, as well as quick adaptation to changes in business conditions or market needs and the state of the market for educational and other services.
5.) Development and maintenance of close cooperation with industrial and other organizations with which the university fosters particularly close relations and cooperation, from Serbia and from abroad.

COURSE OFFERINGS IN THE FIELD OF ARTIFICIAL INTELLIGENCE

Currently the following AI-related courses are offered to student on academic bachelor, master and PhD levels:

1.) Bachelor level courses
- CS360 Artificial intelligence (core)
- CS361 Artificial Intelligence in game development (core)
- CS375 Machine learning (elective)
- CS420 Applications of artificial intelligence (elective)
- CS490 Artificial Intelligence Application Project (elective)

2.) Master of Science courses
- CS515 Principles and Techniques of (core)
- CS565 Machine Learning (core)
- CS520 Applied Deep Learning (elective)
- SE535 Intelligent agents (elective)
- CS525 Computer Vision (elective)
- CS541 Intelligent e-learning systems (elective)
- SE560 Semantic Web Technologies (elective)

3.) PhD courses
- SE625 Intelligent software systems (core)
- SE365 Machine learning (elective)
- SE675 Artificial intelligence in education (elective)

CURRENT AND PLANNED RESEARCH IN THE FIELD OF AI

Research in the field of artificial intelligence at the university is aligned with the above-mentioned research strategy. Some of these researches are currently being implemented as internal projects funded by the university itself, but with the aim of preparing good project proposals that will also receive external funding, either from European or national project funding sources. Part of the research is done with funding from the EU programs (Horizon and Erasmus+) or the Fund for the Development of Innovation or Science of the Republic of Serbia. Research with AI that is conducted, regardless of the source of funding, is listed here, i.e. by narrower areas of research and development, i.e. on the following research topics:

1.) Development of an intelligent creator, i.e. a tool designed to support the hybrid creation of teaching materials for subjects in collaboration with teachers and AI tools (GenAI), which can significantly speed up the preparation of all components of teaching materials.
2.) Development of an intelligent tool for reviewing created teaching materials, i.e. assessing their compliance with quality standards in the field of education.

3.) Development of a generator of pre-examination obligations of the student, such as: tests of different types, with questions and with tasks, project tasks, case studies, seminar work, and other methods necessary for the verification of acquired competencies of students.
4.) Development of tools for automated evaluation of students' submitted pre-examination tasks, which are part of the hybrid student evaluation system, because it ensures the interaction of the teacher and the system in the evaluation process.
5.) Development of an intelligent iMet system for automation and management of all business processes and databases at the university in the areas of learning, teaching, marketing, HR, finance
6.) Research, development and implementation of personalized education, i.e. the possibility that study programs include optional subjects or parts of subjects, which were developed according to the special requirements of individual students or employers, with the aim of enabling students to acquire special and even unique competencies in accordance with the needs of an employer.
7.) Development of an intelligent advisor intended for potential students, with the aim of helping potential students choose a study program and understand its goals, the competencies they offer students, as well as for which jobs and jobs they prepare them for.
8.) Development of an intelligent mentor, a software tool that helps appointed mentors (teachers) to better and more easily monitor the progress in learning and the acquisition of competencies of the students for whom they are responsible, as well as to detect their difficulties in studying in time, and to take appropriate measures to eliminate the students' perceived problems.
9.) Development of verifiers of developed systems with the aim of determining compliance with defined ethical principles in education, sociological and legal aspects and limitations that all the above systems should satisfy.
10.) Research and development of dedicated intelligent systems in various fields of application, with the aim of providing services to industrial partners and other organizations that are transitioning to the digitalization of their business with the application of artificial intelligence.

POSSIBILITIES OF PERSONALIZING EDUCATION WITH THE SUPPORT OF ARTIFICIAL INTELLIGENCE

As the conducted experiments showed a significant increase in efficiency in the preparation of teaching materials using various GenAI tools, it opened up the possibility of applying personalization of learning using GenAI tools. It is now being implemented at BMU, the so-called a three-tier competence model that allows students to prepare and do pre-examination tasks in order to ensure mandatory competences in a subject (level L1), while level L2 provides a deeper study of established competences in one subject, and level L3 provides the possibility of developing the competences of creative and analytical thinking and debating on individual issues, Figure 1.

The student is offered an optional level of competence L2, so that for certain topics, if he wants, he can deepen his knowledge and skills. In order to have the right to sit for the exam, the student must complete the pre-examination requirements to obtain a minimum of 35 points, out of a maximum of 70 (university regulations). However, at the special request of the student, additional teaching materials can be prepared either at the L1 level, (expanding the range of competencies by width), or at the L2 level, in order to enable him to acquire some specific, new competencies, or to deepen the offered competencies. In both cases, quick and efficient preparation of teaching materials is required. This enables the application of GenAI tools, which in interaction with the course teacher (hybrid development of teaching materials), enable the efficient creation of those new and specific learning materials, as well as the evaluation of their understanding and application by the student. These researches, which are now underway

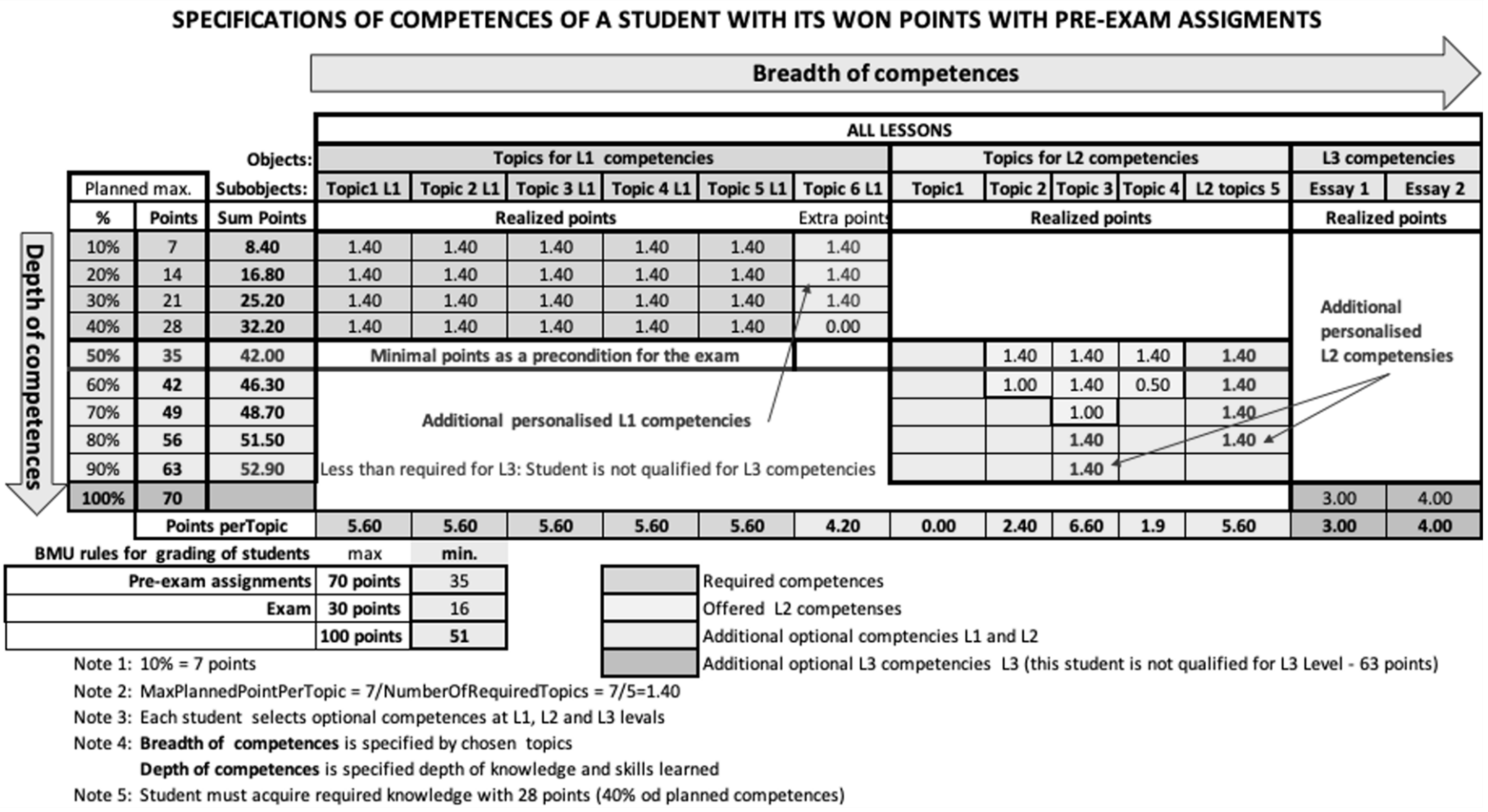


Figure 1. Three-layer model of competencies of a course.

at BMU, point to the importance of applying AI in the personalization of education, which is a growing need, due to the rapid emergence of new technologies that educational programs should as soon as possible support and offer the student, at his request or the request of his future (or current) employer, a specially created course or part of the course. Quick adjustment of personalized teaching materials enables their adjustment during the student's learning process itself, and in accordance with the result he achieves during the learning process, i.e. during the semester.

The three-tier competency model is currently applied in most courses of the Faculty of Information Technologies, the Faculty of Management and the Faculty of Foreign Languages. In the next academic year 2026/27, all courses on bachelor studies at these faculties will apply three levels of competence L1, L2 and L3.

DISCUSSION

The presented program of research and development of intelligent systems for business support of BMU has the following goals:

1.) Providing students, associates and teachers with opportunities to develop their own competencies for the development and application of intelligent systems in various areas of business.
2.) Raising the quality of teaching based on the acquired competencies of teachers and associates through their participation in the mentioned research.
3.) Facilitating the personalization of student education due to the use of artificial intelligence in the preparation of teaching materials.
4.) Digitization of education, research and business of BMU by realizing its gradual digital transformation.

The question arises whether the presented program is too ambitious and possible to implement in the next few years? What are the risks in its realization? What are the disruptive factors that hinder their realization? Therefore, here are the identified challenges:

1.) Are there enough competent development engineers at BMU to carry out the mentioned research?
2.) Can BMU provide the necessary financial resources?
3.) Does the existing regulation in Serbia not represent an obstacle for the realization of certain researches?
4.) Is there interest and mood of teachers and associates at the university to participate in these researches?

We will try to answer these questions.

Add Question 1: Past practice has shown that each generation of students at the Faculty of Information Technologies, which offers study programs in the field of software engineering, IT and information systems and video game development, always has a group of very talented, motivated and creative students. The university has so far offered free study to a number of them and financially financed their participation in the development of its information system. Now they will increase the number of those students, especially from the 2nd year of their studies, and a part of them will, after graduation. As before, he continued to work professionally at the Center for the Development of the University's Information System. They also received the right to free master's and doctoral studies. We will try to ensure that enough of our graduate and master's students participate in the development of these systems, attracted primarily by the attractiveness of the development tasks. In addition, all teachers of the Faculty of Information Technologies will have to be advisers in the Center for Information System Development and to help engaged students with their advice, suggestions and reviews in solving their development tasks.

Add Question 2: In addition to allocating its own funds to support its development, BMU, through its Center for Projects and International Cooperation, strives to provide more and more grants for research and development in the aforementioned research areas, and is open to cooperation with other universities abroad for joint work on the aforementioned research. It is not an easy task in conditions of great competition, but with its past results in international projects, BMU has already gained a reputation as a reliable partner. As a private university, apart from project grants, it does not receive any financial aid from the state. After 20 years of existence, it knows that its work must create funds for research and development, and with various internal measures it encourages and motivates its teachers, associates and students to participate in this.

Add Question 3: As the mission of BMU is to provide its students with quality education, it must demand from teachers and their assistants high quality performance. During the selection of teachers, candidates are informed for what is expected of them, both in the part of preparing all learning materials and in the part of their involvement in development and implementation of innovative student-centric education. They need to participate in R&D of innovative and efficient teaching and learning. For their work, BMU offers incentives for their performance using a performance-based rule book on earnings. Besides the basic salary, their work on the preparation of teaching materials and their involvement in education-related R&D is financed additionally. However, the main motivating factor is the attractiveness of their teaching and research assignments, as they participate in development of a new education, focused on quality and implementation of Ai and latest digital technologies that support personalized education.

Add Question 4: Unfortunately, some regulations in Serbia make it difficult to introduce innovations in education, because they rigidly determine the forms of teaching in study programs that must be implemented. We will cite a few examples:

- An online study program must implement synchronous, not asynchronous e-learning that employed students are usually requesting.
- A synchronous online study program cannot be approved, if the same study program is not also conducted in a traditional way (face-to-face (F2F)) in classrooms. In the case of master's studies, which usually have small groups of students, it is often difficult for HEI to organize parallel and independent traditional (F2F) and synchronous online classes, for financial and organizational reasons.
- The introduction of innovations in teaching, which would enable optimal course-related combinations of different forms of teaching, are not supported by the regulations in Serbia. As BMU strives to apply innovations and modern methods of student learning, such restrictions limit it implementation of these innovations. We hope that those in charge will see these difficulties, and give more autonomy to HEIs to configure teaching each course in an optimal way.
- Globalization of education is an increasingly important trend, because computer networks and online learning provide access to quality education provided by HEIs to all interested students, regardless of where they live. It is also an opportunity for higher education institutions in small countries, with a small population, to significantly increase student enrolment, offering modern, high-quality, but less costly online studies. Accreditation should not specify how HEI provide their education, but what results they are achieving. Instead of requiring a lot of administrative and birocrating rules and constraints, accreditation should evaluate the quality of education that HEIs achieve implementing their own innovative and optimal, course-related educational methodologies.
- Accreditation agencies should not deal with how HEIs should prepare their educational and other services, but primarily with what kind of results they achieve, and give their licenses based on that. This would make it possible to strengthen creativity and innovations in the development of different educational models, especially suitable for online and hybrid

(combined traditional F2F and online) learning, as well as the needs of both students and employers. This is probably more difficult task for them, in comparison of checking a lot of required administrative documents, but monitoring and evaluating performances of HEIs during the accreditation period is more effective way of achieving quality education. Assessment of employers should have and important factor of evaluation of HEIs.

BMU, as a small university (the accredited annual number of new students is limited to 750 students for the integrated part of the university) has a mission to ensure quality and modern education of students, BMU wants to use all the opportunities provided by digital technologies and artificial intelligence to support its digitalization of teaching and business to the greatest extent possible, and to achieve this through continuous steps of its digital transformation, as a means of constantly raising the quality of education it offers to students. Today, when many students demand fast, easy and cheap studies, BMU can only attract those students who want a quality modern and quality education. Therefore, it requires the appropriate work of its teachers, as well as the attraction of new teachers and associates who want to work in such conditions. In order to make this possible, in the coming period, BMU will invest significantly more effort in securing projects that meet its research and development priorities and cooperate with other universities that share the same priorities and values.

By offering high-quality and modern education, BMU now offers, and in the coming period much more, the enrollment of students from abroad, offering them the use of digital translators of its teaching materials and the teaching itself into their language, and vice versa, which artificial intelligence makes possible with increasingly successful and high-quality.

CONCLUSION

Based on the presentation of the state of application of GenAI at BMU and the first experiences gained, the following can be concluded:

1.) Studying the application of AI at the university in various fields and in the fulfillment of professional tasks that students should perform when they get a job is necessary, because the function of education is to prepare them for the application of knowledge at their employers.
2.) However, “click” solutions are not enough when working in an educational institution, because it must teach students to understand well-acquired knowledge and applied concepts, to learn how to solve a problem and how it can be achieved by applying new and digital technologies, including AI. Educational. The institution must also ensure the verification of learned and acquired skills, which is realized with the help of the GenAI tool.
3.) The application of AI in higher education enables teachers to increase the efficiency of lesson preparation, faster preparation of pre-examination tasks and their assessment. Of course, all responsibility rests with the teacher, and he should interact with the GenAI tool, in order to, in a hybrid way, threaten the learning process and verify the achieved results. There are many published research results in the field of AI application in higher education. And it is a solid base for the development of intelligent systems to support learning and teaching, mentioned in fourth section.
4.) The experiments conducted so far with the application of engineering prompts show that the necessary teaching materials for learning and for the verification of what has been learned can be prepared very quickly, if the teacher is skilled in preparing the prompts of the GenAI tool. In order to make it easier for teachers, in upcoming research at BMU, intelligent tools will be developed for optimization and automation of the preparation of the necessary prompts, in order to maximize the speed of preparation of teaching materials and ensure quality control of teaching materials.
5.) In this way, the application of GenAI can provide great and necessary help to educational institutions in the application of personalized teaching and personalized learning. This will

be necessary, because accelerated technological changes require more frequent and rapid changes in the curriculum and programs within individual subjects.

6.) The mentioned possibilities of applying AI and digital technologies require adjustment of regulations in the field of higher education, which must not be a limiting factor, but a stimulating factor in the development of better quality and personalized education, which will be required more and more often.

7.) In addition to the development of technology for the application of GenAI, it is also necessary to apply the necessary and appropriate pedagogical methods of teaching and learning, a way of respecting established ethical principles, copyright and other rights.

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