Overview and Implementation of Artificial Intelligence in the Improvement of Educational Process

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The application of Information Technology (IT) has facilitated the integration of Artificial Intelligence (AI) achievements in various aspects of modern life, including the field of education. This paper analyzes the aspects of AI application in education, focusing on its potential implementation in secondary schools. The research aims to improve the teaching process within high school education by applying the artificial intelligence model. This application of artificial intelligence improves both the efficiency and quality of teaching, leading to an enhancement in students' competence levels. Schools that implement smart classrooms create a better image and greater competitiveness, thus becoming more attractive to a large number of quality students. Artificial intelligence can provide learning assistance, monitor student progress, and recommend learning models. It can be in the form of applications increasingly utilized on computers and smartphones, as well as learning materials available on the Internet. Based on the student's profile, AI can assist teachers in performing routine tasks, such as grading tests, thus allowing the lecturer more time for interaction with the students. To gather the necessary data for analyzing the impact of AI on enhancing the teaching process, a survey was conducted among 400 students from various educational backgrounds in secondary vocational schools. Additionally, a number of articles and well-known leading journals, institutions, countries/regions were analyzed. The study identified works in which the authors explored the application of artificial intelligence. The analysis resulted in the development of a model for improving the teaching process using artificial intelligence and defining the specific steps that need to be taken in order to progress in achieving the priority goals.

Keywords: Content analysis, Knowledge, Knowledge testing, Model, Neural networks

Introduction

Artificial Intelligence (AI) in education deals with the development of computers that perform cognitive tasks usually associated with human minds, such as learning and problem solving. Artificial intelligence in education has been in the field of scientific research for more than 30 years. There is currently a heightened interest in comprehending and promoting the utilization of AI and technology for educational objectives. This interest is not confined solely to educational institutions but extends to governmental sectors as well.

Digital technology, enhanced by artificial intelligence, has played an essential role in human daily life, exerting significant influence on the way individuals think, act, and communicate. Since its inception, artificial intelligence has flourished and prospered, especially with the advent of Artificial Neural Networks (ANN) and Deep Learning (DL). AI has been introduced into the field of education through various channels and in various forms.

Results and achievements from various disciplines and fields, especially from computer science, have dramatically influenced the way people study and learn.[1] AI technology presents possibilities for implementing personalized learning experiences for students, custom-tailored to address their unique requirements.

As all students possess independent and unique learning styles, abilities, and needs, it can be challenging for each student to acquire necessary knowledge using traditional educational methods. However, with AI, instructors can cater to the needs of all students depending on the abilities of each individual.[2] Consequently, students become more motivated, engaged and more independent in the learning process. In addition, AI technology provides avenues for bolstering the involvement of students facing learning challenges or disabilities.

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AI-driven applications and tools, such as intelligent robots and adaptive learning systems, are progressively finding their way into the educational landscape from kindergarten through high school (K-12) and onward into higher education institutions. With the increasing application of AI technology for teaching and learning, instructors are offered the opportunity to free themselves from repetitive and tedious tasks and to respond to students in a timely manner, thus improving the adaptive and personalized teaching process.[3] Advances in hardware, such as high-speed graphics processing units, coupled with the accessibility of diverse software libraries, has spurred the adoption of AI technology. This is particularly evident in the flourishing research on deep learning and the integration of data analysis methods. The future development of education will largely be closely related to the development of artificial intelligence. Rapid industrial and technological progress over the last 150 years has caused radical changes in traditional human society. The research focuses on the potential role of computers and artificial intelligence in shaping the future of education within our modern knowledge society and globalization. As a result, formal education at all levels, from primary to tertiary, faces the great challenge of preparing students for the forthcoming era of the new, albeit undefined industrial revolution, characterized by the Internet of Things, as well as energy and cyber-physical systems controlled through it. It is inevitable that the role of the teacher will undergo dramatic changes in the classrooms of the future.

Research Objectives

This research aims to explore and assess the knowledge and familiarity with artificial intelligence and its application among high school-aged youth. Moreover, the paper focuses on investigating the possibility of applying artificial intelligence in secondary schools, defining the methodology, assessing the impact of AI on teachers and students, and developing models that contribute to the enhancement of teaching quality. We have developed a survey on the topic "Familiarity with AI applications in teaching process". The survey involved 400 students from the secondary technical school in Ivanjica, Serbia. In accordance with the formulated research subject, the primary goal related to the implementation of Artificial Intelligence in secondary education was established.

Specific objectives include the following:
- to determine the basic knowledge about artificial intelligence among high school students;
- determine the desire of respondents to learn more about artificial intelligence;
- determine the possibilities of applying artificial intelligence in the teaching process and its impact on education.

Motivated by the boom in the development of AI in education, it is important for this research to clarify the definition of AI, and its interconnectedness with related fields such as Educational Data Mining (EDM), Computer Science Education (CSE), and Learning Analytics (LA). Given the growing number of articles on AI in education, conducting a systematic review of AI in education is crucial to identify the most influential research studies, their distribution, development, main contributors, and research focus. Consistent with our literature survey, no systematic analysis has focused specifically on the influential AI research literature in education, highlighting the need to explore this area of research.

The aim of this systematic analysis, as the first in-depth endevour, is to thoroughly review influential research studies on AI in education published in indexed journals, in order to understand the overall application of AI technology in education. Additionaly, we make it easier to understand "the current research focuses in AI in education" by exploring the most commonly used terms in highly cited studies of AI in education. Thirdly, by systematically examining the AI technology utilized in each of the studies focused on AI in education, this review can help scholars understand the types and extent of AI techniques adopted in current research on AI in education. This comprehensive understanding, which has received widespread attention and significant impact, provides insights into future directions, including potential new technologies and applications of AI in education. It has provided a definition of AI in education from both expansive and specific viewpoints, elucidating the interconnections between AI EDM and LA, in order to provide a criterion for better classification of AI studies in education, as well as tracking the research development stage. This review is necessary and essential to connect existing research on AI in education and future trends in the application of AI technology for educational purposes.

The basic hypothesis (H_0) of this research is:
- (H_0) Students' knowledge can be improved by applying AI in certain teaching subjects. By developing a model for improving the educational process using artificial intelligence in secondary schools, the quality of teaching is improved and functional knowledge is improved.

Special hypotheses of this research are:
- (H_1) There is a difference in the knowledge of artificial intelligence among the respondents;
- (H_2) To improve the teaching process, there is a need for a greater integration of AI in school subjects is needed.

The significance of our study for the field of AI research in education manifests in several ways:
1) Providing scholars dedicated to educational technology with insight into the current status and emerging trends of AI research within education, particularly regarding influential studies;
2) It helps researchers identify the most influential studies of AI in education and be more aware of what kinds of AI technology and what types of contexts can be accepted to help achieve educational purposes;
3) It ensures the recognition of influential institutions and countries/regions that are potential research collaborators of AI in education. This awareness aids researchers in discerning key research focuses and influential inquiries;
4) Supporting newcomers to the field is by acquainting them with the prevalent theories and technologies commonly adopted in highly cited studies of AI in education; commonly utilized in highly cited AI studies within education;
5) Enabling scholars to identify influential journals that publish AI studies in education. Furthermore, the findings obtained from our study offer valuable insights for decision-makers, such as educational institutions and governments, in allocating resources for the design and implementation of scientific, technological and educational initiatives.

Relevant Studies

In a thorough and organized overeview of the influential Artificial Intelligence in Education literature[1], researchers studiously analyzed 45 articles. This analysis included examining the annual distribution of publications in leading journals, identifying key contributing institutions and countries/regions, determining the most commonly used terms, and assessing the theories and technologies employed. The definition of AI is assessed from both a wide-ranging and more focused perspective and the relationship between AI, educational data mining, computing education and learning analytics is clarified. The results in the above research showed that:

1) The interest and influence of AI research are consistently expanding;
2) There has been deep learning technology within educational settings;
3) Traditional AI techniques, like natural language processing, are usually utilized in an educational context, with more sophisticated techniques being less frequently utilized;
4) There is a scarcity of studies employing AI technology that delve deeply into educational theories.

Progress in the field of artificial intelligence is shown by a research study[4] which presents a spectrum of challenges and opportunities for professionals in the realm in education. A pilot new curriculum for artificial intelligence has also been developed in many primary schools in China, in Beijing. The research found that intrinsic motivation emerged as the predominant factor shaping career motivation, with motivational tactics such as attention, relevance, and self-confidence also exerting significant influence. The findings serve as a reference for future AI curriculum development. Troubleshooting hardware upgrades and application software installation is part of the core competencies of computer and basic networking knowledge and skills. Based on the observations, the learning process was not able to accurately depict the issues that commonly arise with computers.[5]

In the last decade, there has been an increased focus on understanding the formation of categories – cognitive abilities of children of preschool age.[6] Children organize their knowledge of real-world objects by categorizing them according to some common properties or functions. The advancement and popularity of touch screen mobile devices provide a good opportunity for young children to learn and practice. The results show that children who experienced dynamically created examples of categorization derived from modeled knowledge

achieved higher results compared to those who followed traditional teaching using books and worksheets, which indicates the increasing popularity of advanced technology among children from the earliest age.

The gradual ascent and evolution of AI were not abrupt occurrences. As artificial intelligence exerts a greater impact on humanity, the urgency to comprehend it becomes more pronounced. AI has the capacity to enhance human learning, skill development, and overall performance, thereby facilitating proficiency and efficacy in various tasks and endeavors.[7]

The use of artificial intelligence can improve human well-being in numerous aspects. Much of the current discussion of AI technologies revolves around its potential to enhance human creativity across in many areas of creativity. Beschatka Intelligence advocates for fostering a deeper dialogue between technology-based and human-based researchers to improve understanding from different perspectives.

In recent years, great efforts have been made to promote literacy for citizens using AI. The results of this study contributed to the design, implementation and evaluation of an AI literacy course for students at various universities.[8] The course included 4,000 students and 120 volunteers, and it lasted 7 hours. The underlying question was whether students from diverse academic backgrounds could acquire a conceptual grasp of AI via a literacy-focused course. The results of pre- and post-course surveys showed that participants made significant progress in understanding AI concepts, and felt confident working with AI. The above results showed that participants of different studies and gender could understand the concepts of Machine Learning (ML) and artificial intelligence, supervised learning, regression, classification, unsupervised learning and clustering. Moving forward, the AI literacy course could potentially broaden its scope to incorporate practical AI application projects and facilitate discussions on ethical considerations pertaining to the extensive utilization of AI in society. The purpose of this study was to design and develop a learning tool through AI applications for computer problem solving. The authors of this research analyzed the problems and made improvements on the hardware and installation of application software, as part of the basic competencies of knowledge and skills of computers and basic networks. The method of

research and development with a 4D model was used.[9] The results of the study show that this application is valid, practical and effective. The results of the study show that the application of artificial intelligence in solving computer problems has been successfully designed and developed.

In a world dominated by technology, useful and timely information can be quickly accessed through Intelligent Personal Assistants (IPA).[10] By using these assistants built into mobile operating systems, users can effortlessly accomplish their daily electronic tasks around the clock. Tasks such as dictating, getting step-by-step instructions, accessing advertisments, sending messages and emails, setting reminders for daily appointments, obtaining answers to all factual questions, and launching applications can all be performed using IPAs, such as Apple's Siri, Google Now and Microsoft Cortana.

Said assistants programmed within AI create facilitate human-computer interaction through the utilization of natural language in digital communication. In this regard, the general purpose of this study was to examine the possible use of intelligent personal assistants using advanced cognitive computing technology and natural language processing for learning. In pursuit of this objective, the operational framework of IPA was briefly reviewed under AI which has recently advanced to predict, comprehend, and execute multi-tiered and intricate user queries.

The Arkansas Computer Science and Computing Initiative standards for high school courses are designed to provide an understanding of computer science concepts necessary for students to function in an ever-changing technological world.[11] Standards give students the tools and skills needed to succeed in college and careers, including computer science and other fields. These common standards address the basic knowledge and skills required for any student entering a technology-based field. Course standards are grouped into one-credit standards (usually per year) to allow the classroom teacher additional flexibility in curriculum selection. However, course codes remain based on one half credit (usually a semester). The research study shows us that the strategy is designed to help teachers in primary and secondary schools to increase their level of computer literacy.

The possibilities, limitations, applications and possible effects of computers on education are

increasing.[12] The analysis begins by defining computers and explaining the book's goals and applications, through technical overviews of microcomputers and computer software and hardware, with an appendix on calculators and discussions of computer output devices, the computer's central processing unit, computer memory, and video disks. Based on an analysis of the ability of computers to provide "automatic flash cards" for students by computers, and based on the application of various educational computer games, the history of automated symbol manipulation and the development of computer languages such as FORTRAN and BASIC are discussed. The focus of the analysis is on the use of computers to solve problems and on the application of possible applications, and modeling of the appropriate model for the improvement of the teaching process.

Nowadays, AI and human intelligence coexist, and no field is exempt from the influence of artificial intelligence. Currently, one cannot talk about education inherently incorporate AI, as its influence extends ubiquitously across all facets including objectives, content, methodologies, and assessment frameworks. Through a thorough examination of AI current impact and prospective ramifications, some future directions of education have been determined.[11] The proliferation of research papers on AI in education has exhibited a consistent rise over the past two decades, with a particularly pronounced surge since 2015. The study found that research on AI in education needs to be more thematically diverse and in-depth, particularly focusing on the direct application of AI algorithms and technology in education.[13] This aspect requires further promotion. Based on the analysis of all mentioned research results, the creation of a model for improving the teaching process under the influence of AI will be started.

AI provides methods for merging and analyzing data, thereby improving our comprehension of the tactical environment. Additionally, it provides methods for generating and evaluating decision options from multidimensional, complex situations. Furthermore, it provides predictive analytics to identify and examine the effects of tactical courses of action. Machine learning can improve these processes in an evolutionary way.[14]

Education chatbots are designed for educational purposes and can be seen as an Internet of Things interface that is expected to revolutionize the educational process. Such chatbots are designed to provide personalized learning through the concept of a virtual assistant that replicates human conversation. However, as an educational paradigm, chatbots are still new and there are numerous challenges in facilitating, implementing, designing, and integrating them as an effective educational tool in various areas, some of which are problem-based, research-based, and project-based teaching.[14]

From the research of the aforementioned studies, it is evident that there are no specific solutions that would increase the students' ability to learn subjects and the impact of AI on the educational process. In this paper, the focus will be on the proposal of a model for improving the teaching process through the utilization of AI, based on the results of the research conducted in the high school.

Mehtodology

To accomplish the objectives, AI is applied in conjunction with the associated methodology. This methodology encompasses the following distinct research tasks: data collection, pre-processing, and transformation.

A schematic view of the planned research is shown in Fig. 1.

Data Collection

In order to collect, process, and analyze data, as well as present the results, the model's development relies on employing the following research techniques:

a) For primary data: surveys, tests of knowledge about artificial intelligence, self-assessment scales (most of the tools were developed by the authors);

b) For secondary data: data on the success of students from internal records in the high school institution and external data on high school programs of subjects in the field of IT (publicly available data of the Ministry of Education and Ministry of Science,
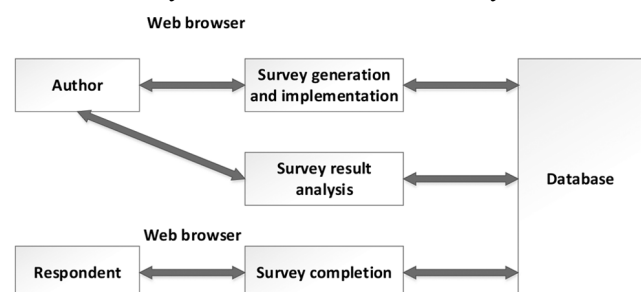

Fig. 1 — Planned research

Technological Development and Innovation of the Republic of Serbia).[15–17]

Data Pre-processing-and Transformation

The sample consists of 400 four-year students of the Vocational Secondary School in Ivanjica, from five educational profiles. The number of students who participated in the study is shown in Table 1, including grade in high school and gender.

The data was collected in the high school, from the school secretary, the database and in contact with the students. All relevant data were collected: high school, major, previous knowledge. Students had a test with questions and assignments from programming.

For the research composite, a measure of success was established, which includes positive answers to certain questions in the questionnaire and the percentage of familiarity with various tools related to the application of artificial intelligence. Levels of success in knowing artificial intelligence are defined as:

1 – Very successful students (success rate > 70%);
2 – Students with an average level of success (success rate > 40% and ≤ 70%);
3 – Students with low success or failure (success rate ≤ 40%).

Representation of AI in Primary and Secondary Education

In this section, the presence of artificial intelligence in primary and secondary education will be discussed. Analyzing curricula and programs on the portal Institute for the Improvement of Education and Training (IET) led to the conclusions shown below.

In the eighth grade, artificial intelligence is introduced through the field of Digital Literacy, encompassing two classes. In grammar schools, artificial intelligence is studied through the field of Contemporary Technology with 10 hours of study. However, in secondary vocational education, the inclusion of artificial intelligence in the curriculum is minimal. Only two educational profiles, Electrical Engineering and Informatics, incorporate artificial

intelligence in their curriculum through the courses such as Automation of Production and Flexible Technological Systems course as well as the course on Robots.

Creating a Model for Improving the Teaching Process

The number of students, according to gender and high school grade, who participated in the research is given in Table 1.

The path to excellence of Artificial Intelligence in the Improvement of the Teaching Process is through satisfying the standard with the aim of improving the quality of processes and products based on the sources of knowledge standardization of AI requirements.

Research Study

The research study analyzed curricula and programs to assess the integration of Artificial Intelligence into secondary education, aiming to identify the potential applications and areas of use of artificial intelligence and machine learning within secondary schools (Table 2).

Curricula and programs were analyzed on the portal Institute for the Improvement of Education and Training, leading to several conclusions, shown below.

The proposed measure is to increase the presence of artificial intelligence in a greater number of classes across all educational profiles in secondary vocational schools and grammar schools.

The sample included secondary vocational school students who can understand questions, terminology and express their views. At the same time, we are talking about an age that intensively uses digital technology.

For the research, a questionnaire was constructed for the students, which consisted of 20 questions. Some questions allowed for "yes" or "no" responses, while others provided multiple-choice options. Additionally, students had the opportunity to express their opinions in writing.

The analysis of the questionnaire is presented in the Research results section. The paper primarily focuses on defining a proposed model for enhancing the teaching process using artificial intelligence.

The authors aim to demonstrate how teaching in secondary schools should be improved through the application of artificial intelligence. The proposed measure entails increasing the presence of AI in the curriculum by incorporating it into certain subjects.

Table 1 — Number of students by gender and high school grade

Class	Female	Gender	Male total
1	43	48	91
2	41	68	109
3	67	58	125
4	48	27	75
In total	199	201	400400

Table 2 — Topic recommended contents

Topic	Recommended contents	Outcomes
• *Eighth grade* • Area Digital literacy[15], (2 hours) • "Official Gazette of RS", no. 88/17, 27/18 - dr. law, 10/19 and 6/20)	- Concept and application of AI - Present and future of artificial intelligence – ethical issues	- Explain the concept of AI in your own words - Give examples of the use of AI in everyday life - Explain the impact of AI on human life
• *Grammar School* • Natural sciences and mathematics major - fourth grade, field of modern computing[16] (10 hours) • Official Gazette - year LXIX - Number 4 Belgrade, June 2, 2020.	- Artificial intelligence (concept, examples of modern systems, ethical issues) - Machine learning (concept, application and importance) - Machine learning models (concept, model generalization, model evaluation, model quality measurement) - Machine learning software (programming languages and libraries) - Collection and organization of data - Machine learning algorithms - Improvement and visualization of results	- Explain the concepts of artificial intelligence and machine learning and determine possible areas of their application in everyday life - Describe some machine learning models - Distinguished types and basic problems of machine learning - Name programming languages and libraries that can be used for machine learning - Describe the basic techniques of data research in machine learning - State and explain the working principle of some machine learning algorithms - Evaluate the quality of the built ML model - Explain the importance of improving and visualizing results in ML - Cooperate in a team, respecting differences in opinion and interests, making a personal contribution to reaching an agreement and affirming tolerance and equality in dialogue
• Socio-linguistic major and first type of high school • Area of modern computing[16] (11 hours)	- Artificial intelligence (concept, examples of modern systems, ethical issues) - Machine learning (concept, application and importance)	- Explain the concepts of artificial intelligence and machine learning - Determine possible areas of their application in everyday life
• Electrical engineering and informatics Technician for industrial robotics Subject – Automation of production and flexible technological systems Artificial intelligence[17] • ("Official Gazette of RS – Educational Gazette", number 9/2019), (5 hours)	- Areas of AI and neural networks	- Explain the concept and role of AI and neural networks
• Electrical engineering and informatics Technician for industrial robotics Subject-Robots third year Artificial intelligence[17], (12 hours)	- Methods and techniques in ML	- explain the concept of AI - state and explain the properties of AI - explain the concept and strategies of machine learning
• Subject Robots four-hour Topic Robotics and Artificial Intelligence[17] (10 hours)	- Recommended content research goals in the field AI - methods and techniques in AI planning of tasks, paths, final movement and modeling	- understand the goals of research in the field of AI - distinguish methods and techniques in AI - understand task planning, modeling - explain the concept and role of artificial neural networks

The analysis of the data from Table 2 indicates that AI and ML are essential technology that improves learning, particularly in developing student skills. Collaborative learning in secondary education represented with a minimum number of class.[15] The goal of artificial intelligence is to be applied in as many areas as possible, and today it is practically impossible to find an area where artificial intelligence does not bring certain advantages.

Results and Discussion

In this section, the results obtained through the survey are presented and analyzed. The research was conducted in a secondary vocational school, involving

400 students from five educational profiles were included. The sample (students) was selected from a vocational school with profiles (major) in which there is a possibility of applying artificial intelligence in the teaching process.

Diagrams are shown for individual answers. In the first question, the students were asked to indicate their familiarity with the terms artificial intelligence and machine learning based on their previous schooling. The results indicate that 71% (284 students) are familiar with these concepts, while 29% (116 students) have not heard of artificial intelligence and machine learning in their previous schooling (Fig. 2).

The second question inquired about the students' familiarity with the application of AI in games. Out of the total number of respondents, 288 students, very successful students (success rate > 70%) answered "yes", while 112 answered "no" (Fig. 3).

The third question was about the popularity of the Python language for artificial intelligence. The students' answers indicate that 240 students (62%) – very successful students (success rate > 70%) confirm the stated statement, and 160 students (38%) – students with low success or failure (success rate ≤ 40%) give the answer "no", Fig. 4.

When it comes to the fourth question "Is it today possible to unlock a mobile phone based on your face?", the answer "yes" was given by 329 respondents, while 71 students answered "no" (Fig. 5).
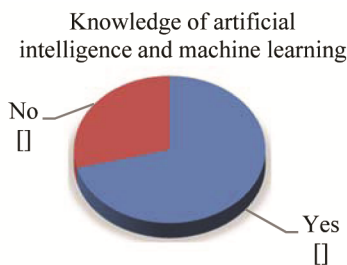
Question five was "Is it possible to identify a person on the street using security cameras?". Out of the total number of surveyed students, 340 answered "yes", 60 students answered "no". The sixth question was "Can a computer recognize human handwriting?" The responses indicated that 219 students thought that a computer could recognize human handwriting, while 181 students answered "no" to this question.

To the question "Can we expect fully autonomous cars?" 300 respondents answered "yes", while the other 100 students answered "no", Fig. 6.

The eighth question was "Are completely automated stores without employees a reality?" 188 students gave an affirmative answer to this question, while 212 respondents believe that automated stores without employees are not a reality.

Question number 9 was: "Have you noticed that if you search the Internet for ads for an apartment, English language classes, or certain shoes, etc., soon

Knowledge of programming language for AI

Fig. 4 — The answer to the question "Is Python the most popular language for AI?"

Unlocking your mobile phone with your character

Fig. 5 — The answer to the question "Is it possible today to unlock a mobile phone based only on your face?"

Knowledge of artificial intelligence and machine learning

Fig. 2 — Answers to the question about knowledge of the terms "artificial intelligence" and "machine learning"

Knowledge of AI applications
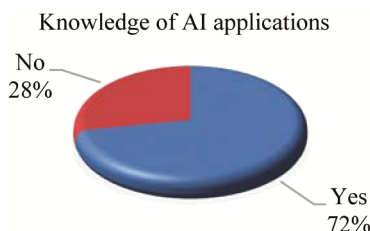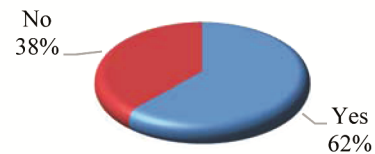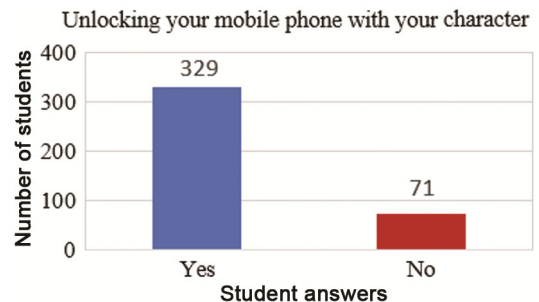
Fig. 3 — Answer to the question about knowing the application of AI in games
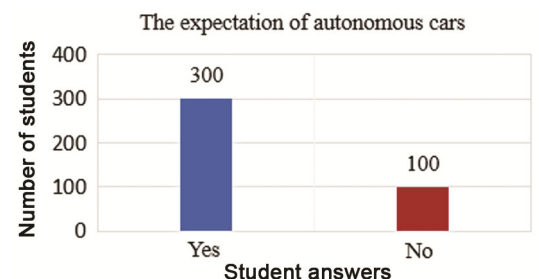
The expectation of autonomous cars

Fig. 6 — The answer to the question "Can we expect fully autonomous cars?

ads will appear on all your social networks that offer exactly these (previously searched for) types products?" Out of the total number of surveyed students, 311 answered "yes", while 89 students answered "no".

Artificial intelligence allows certain machines to perceive the environment around them and react to it in a manner similar to the human brain. This implies the ability to perform functions such as reasoning, perception, learning and problem-solving. Machine learning is a process formalized through mathematical-algorithmic bases, so that intelligent systems apply different learning strategies that use the principles of artificial intelligence. Question 10 addressed the potential application of AI in environmental perception, specifically emphasizing that machine learning incorporates adaptive mechanisms enabling an artificial system (e.g., computer, robot, etc.) to learn from experience, examples, or analogies. 68% respondents gave the answer "yes", while 32% of them answered "no", Fig. 7.

Therefore, that machine learning includes adaptive mechanisms that allow an artificial system (eg computer, robot, etc.) to learn based on experience, by example or by analogy, 252 respondents gave the answer "yes", while 148 of them answered "no", Fig. 8 (Question 11).

Modern Internet technology promotes the use of Cloud-based services, such as the Internet of Intelligent Devices, as well as the use of smartphones, smart sensors and other modern devices, which open up new ways to connect, communicate, and solve problems. 307 surveyed students answered "yes" to this question, while the other 93 respondents answered "no".

A smart city should use all the advantages of the Internet, more precisely, use the collected data and technology for greater efficiency, improving sustainability, creating economic development, and improving the quality of life for people who live and work in the city. 264 students agree with the stated statement, while 136 of them disagree with it, Fig. 9.

The fourteenth question stated: "The smart parking project should allow drivers to find a parking space faster. This capability should also contribute to the reduction of traffic congestion". 293 respondents answered "yes", while 107 of them answered "no" to this question.

Question number 15 read: "Smart classrooms can be divided into the following: virtual assistants, automated lecture recording, digitization of written materials, audio-video conferencing systems, and virtualization of participants". Out of the total number of surveyed students, 272 agreed with the given statement, while the other 128 disagreed, Fig. 10.

The sixteenth question was about the familiarity with the tools that can be used in STEM classrooms.
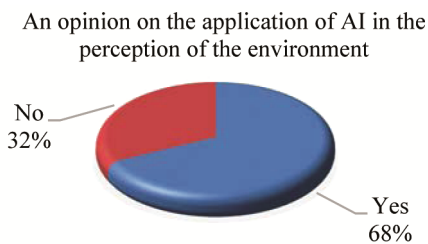

Fig. 7 — Answer to the question about the possibility of applying AI in the perception of the environment
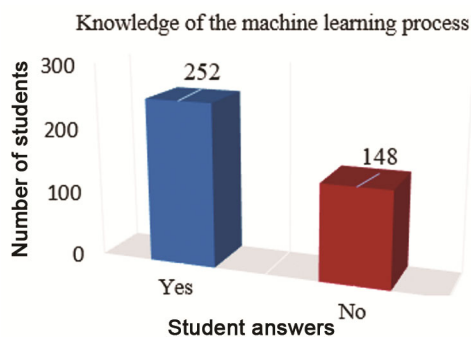

Fig. 8 — Answering a question about knowledge of machine learning, including adaptive mechanisms that enable artificial learning based on experience
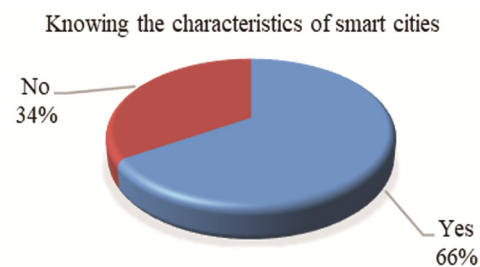
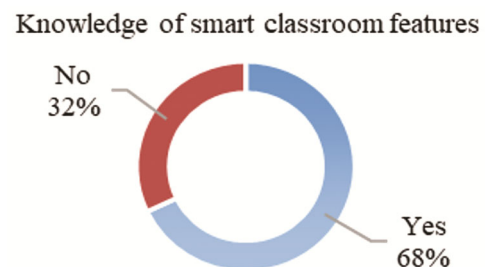

Fig. 9 — Answer to the question about smart cities

Fig. 10 — Answer to the question about the features of smart classrooms

Student responses are as follows: PhotoMath, a free AI application for teaching mathematics, is used by 168 students, Duolingo, a foreign language learning application, is used by 100 students, Code Week, a tool that provides a wide variety of teaching and learning tools, is used by 68 students. Tools Seek by iNaturalist – an app that helps identify species in photos and Verse by Verse – an app for language classes where students can write a poem with the help of artificial intelligence and learn about American poets are used by 20 students each. Newspaper Navigator, a search tool for millions of historical newspaper photos, and Socratic and Brainly tools that can be used to all subjects are used by only 12 students. The MuseNet music research and creation tool is not used by any student, Fig. 11.

1) PhotoMath, a free AI application for teaching mathematics
2) Seek b iNaturalist, an application that helps identify species in photos
3) Verse by Verse app for language classes where students can write a poem with the help of artificial intelligence and learn about American poets
4) Duolingo, an application for learning foreign languages
5) Newspaper Navigator, a tool for searching millions of historical newspaper photos
6) MuseNet a tool for researching and creating music
7) Socratic and Brainly tools that can be use for all subjects
8) Code Week tool that provides a large selection of teaching aids and learning aids

The seventeenth question referred to smart environments with which the students were familiar
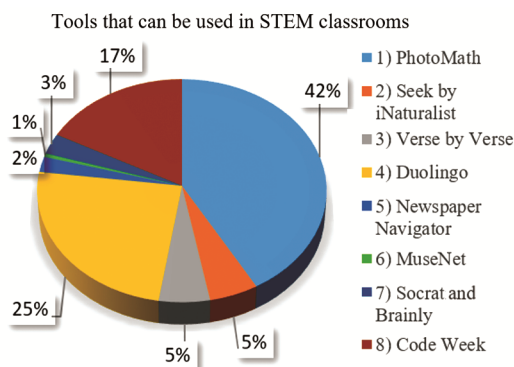

Fig. 11 — Well-known tools that can be used in STEM classrooms:

with in their previous schooling. The answers are given in Table 3.

The last three questions in the questionnaire were open-ended questions. The eighteenth question was: "How do you imagine the progress of technology in the future, which of today's modern technology will not exist in the future, and which will be developed"? The nineteenth question was: "What does life look like when the results of artificial intelligence are used (provide an example)". The 20th question read: "How do you imagine an artificial intelligence"? A large number of students did not answer these questions, mostly responding with "I don't know". A small number of students who answered the last three questions in the questionnaire imagine the future progress of artificial intelligence, as well as innovations in this field.

The main goal of the research is to create a clearer understanding of the use of AI in education, including how frequently it is employed, in what way and to what extent it contributes to making education more innovative. Drawing from the analysis of the findings, the following can be determined:

- It is necessary to explore the potential of applying AI[18] in physical classrooms;
- There is a need to recognize the detailed relationship between the students' responses and the targeted conceptual comprehension within intelligent tutoring systems;
- Greater emphasis ought to be placed on implementing cutting-edge deep learning algorithms, including but not limited to generative adversarial network;

Table 3 — Smart environments

Smart environments that students are familiar with in their education so far	Number of students	Percentage of representation (%)
Smart cities	40	10
Smart houses	44	11
Smart classrooms	104	26
Smart offices	32	8
Smart traffic	28	7
Smart industry	8	2
IoT in trade, logistics and marketing	0	0
Smart agriculture	28	7
Smart power grids	8	2
IoT in e-health	12	3
Smart e-governance	72	18
Security in Smart Environments	12	3
Trends in IoT	12	18

- Machine learning and imaging technology should be combined in order to improve answers to questions concerning students during the learning process and
- We must ensure that the application of AI[19] technology closely aligns with educational theories.

This study had two goals:
1) Validates the factor structure of students' motivation to learn AI and
2) Investigate potential gender differences in students' motivation to engage with AI (Table 1).

In this study, an approach that models structural and functional categorization knowledge is proposed for the development of a mobile learning system with dynamic categorization examples.

The results of our research showed that high school students are not sufficiently familiar with AI. This confirmed the based hypothesis (H_0), which assumed that students' knowledge can be improved by applying AI in certain teaching subjects. Special hypotheses (H_1 and H_2) that there is a difference in knowledge of artificial intelligence among respondents were also confirmed.

By improving the presence of artificial intelligence with a greater number of classes in the majors and profiles of secondary schools, individualized learning will be improved in different ways:

- Facilitating the development of student skills;
- Creating an environment conducive to collaborative learning within high school institutions;
- Improving the security and efficiency of the institution;
- Providing a quiet, flexible, and easily accessible computing environment that allows students to focus solely on learning.

Proposal of a Model for Improving the Teaching Process by Applying Artificial Intelligence

In this questionnaire-based study of 400 high school students, modeling was used to test the hypothesized a model consisting of six motivational factors and strategies: intrinsic motivation, career motivation, attention, relevance, confidence, and satisfaction. A large percentage of respondents (62%) state that Python is the most popular language for artificial intelligence (group of questions 1, 2, 3).

75% of the respondents gave an affirmative answer to the question stating that fully autonomous cars can be expected, while the remaining 25% of students gave the answer "no", (group of questions 4, 5, 6, 7).

The machine learning includes adaptive mechanisms that allow an artificial system (eg computer, robot, etc.) to learn based on experience (68%), (question group 8, 9 and 10).

Modern Internet technology promotes the use of Cloud-based services, such as the Internet of intelligent devices, but also the use of smartphones, smart sensors and other modern devices, which open up new ways to connect, communicate, and then solve problems. To this question, 77% of the surveyed students gave the answer "yes", while the other 23% answered "no" (group of questions 11, 12, 13).

The smart parking project should allow drivers to find parking spaces faster. This possibility should also affect the reduction of traffic congestion. Accordingly, 73% of respondents answered "yes", while 27% answered "no".

That smart classrooms can be divided into the following: virtual assistants, automated recording of lectures, digitization of written materials, systems for audio-video conferences and virtualization of participants, 68% of all surveyed students answered "yes", while the other 32 answered "no", (group of questions 14, 15).

The concept of "Smart classrooms" is understood by 26% of students. 18% of students are familiar with the e-administration environment. The concept of "Smart houses" is understood by 11% of students, "Smart cities" by 10% of students, "Smart offices" by 8% of students, "Smart traffic" and the concept of "Smart agriculture" by 28% of students. 3% of students were familiar with the terms "IoT in e-health", "Security in smart environments" and "Trends in IoT". The concept of "Smart power grids" and "Smart industry" is introduced to each student. The students are not familiar with the IoT environment in trade, logistics and marketing (group of questions 16, 17).

A large number of students did not answer the last three questions. The answers are mostly "I don't know". A small number of students who answered the last three questions in the questionnaire imagine the future progress of artificial intelligence, as well as innovations in this field, (group of questions 18, 19, 20).

Applications of artificial intelligence in education should enable more purposeful, dynamic and interesting learning. It is precisely artificial intelligence that offers the possibility of improving educational systems in a way that was not possible until now. Through innovations in learning, as well as the use of AI, the multi-year gap between learning methods and the material itself, on the one hand, and the technological possibilities of the modern world, on the other, can be overcome.

Integrating AI into curricula requires a holistic approach, which includes analyzing student needs, training teachers, and selecting appropriate tools. For this purpose, the realization of the questionnaire was carried out.

The analysis resulted in the development of a model for improving the teaching process using artificial intelligence and defining the specific steps that need to be taken in order to progress in achieving the priority goals.

Artificial intelligence is on an unstoppable path of development. One of the ways in which hybrid artificial intelligence has proven to be very effective is certainly the introduction of chatbots into everyday activities. Today, digitization is present in all aspects of human life, including the way we learn. Although we are far from the systems that think and behave like humans, artificial intelligence has begun to help us in our daily lives by saving our money and time.

Conclusions

The key contribution of this study are providing an overview of the results of research on application in the field of AI, which resulted in an original model for improving the teaching process; and application of AI in teaching enables the identification of potentially successful and unsuccessful students.

The advantage of this study is that it has explored the overall history of a particular research area as opposed to focusing only on a specific time period. It confirmed that the based hypothesis (H_0), assumed that students' knowledge can be improved by applying AI in certain teaching subjects, in order to progress in achieving the priority goals.

This research shows the importance of correlation between the processes of knowledge acquisition, the application of AI, and AI in education. The model for improving the teaching process is "understanding the needs of students", more precisely "identifying areas where AI can help improve the learning experience". Teachers play an important role in the development of this model, and therefore their training on the use of AI tools is "necessary". Future research could focus on a detailed analysis to identify the specificities of use AI in educational process.

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