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The role of AI in individualizing learning and creating personalized programs

El papel de la IA en la individualización del aprendizaje y la creación de programas personalizados

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Abstract

This article analyses the technical and methodological aspects of implementing individualised curricula using artificial intelligence in the educational process. The study deals in detail with the issues of technological infrastructure, data collection, and processing, as well as the integration of individualised programmes with existing educational platforms. The methodological aspect of the article includes an analysis of methods for determining the needs and capabilities of each student and the development of a methodology for assessing the success of individualised programmes. The study aims to uncover the potential and benefits associated with the utilization of personalized programs in contemporary education. This is done with the intention of enhancing the overall learning experience and attaining superior outcomes for every individual student and pupil. Future areas of research include further development of technical solutions for individualised programmes, studying

Resumen

Este artículo analiza los aspectos técnicos y metodológicos de la aplicación de programas de estudios individualizados mediante inteligencia artificial en el proceso educativo. El estudio aborda en detalle las cuestiones de infraestructura tecnológica, recopilación y procesamiento de datos, así como la integración de los programas individualizados con las plataformas educativas existentes. El aspecto metodológico del artículo incluye un análisis de los métodos para determinar las necesidades y capacidades de cada estudiante y el desarrollo de una metodología para evaluar el éxito de los programas individualizados. El propósito del estudio es revelar las posibilidades y ventajas de utilizar programas individualizados en la educación moderna para mejorar la calidad del aprendizaje y lograr mejores resultados para cada alumno y estudiante. Entre los futuros campos de investigación figuran el desarrollo de soluciones técnicas para los programas individualizados, el estudio de enfoques metodológicos para adaptar los programas a las

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methodological approaches to adapting programmes to the needs of different categories of student, and developing ethical standards for protecting personal data in education. This article will be useful for teachers, higher education institutions, researchers, and anyone interested in using artificial intelligence to individualise learning and improve education. It offers important discoveries and practical recommendations for implementing individualised programmes in the educational process.

Keywords: individualisation of learning, personalised educational programmes, artificial intelligence, machine learning, data analysis.

necesidades de las distintas categorías de alumnos y el desarrollo de normas éticas para proteger los datos personales en la educación. Este artículo será de utilidad para profesores, centros de enseñanza superior, investigadores y cualquier persona interesada en utilizar la inteligencia artificial para individualizar el aprendizaje y mejorar la educación.

Palabras clave: individualización del aprendizaje, programas educativos personalizados, inteligencia artificial, aprendizaje automático, análisis de datos.

Introduction

The significance of the selected subject arises from the necessity to implement creative methods in the field of education. Due to the constant changes in technology and social requirements, an individual approach to learning is becoming a key element in improving education. Today, most educational systems face the challenge of providing an effective learning process for each student, taking into account their unique needs, learning styles, and pace of learning.

In this context, the use of artificial intelligence (AI) provides an opportunity to transform and individualise this process, taking into account the specific needs and ability level of each student. Machine learning and data analytics technologies allow for the creation of personalised programmes that are adapted to the specific educational goals and needs of students (Chanysheva et al., 2023).

The term “artificial intelligence” or “AI” is commonly used, but it can be very difficult to define and explain to the average person. In the perception presented mainly by cinema and literature, AI takes the form of a fantasy rather than a real understanding of the technological aspects behind the concept. The reality, however, differs significantly from the images that can be found in contemporary cultural discourse (Etzrodt et al., 2022).

For more than eighty years, humanity has come a long way, experiencing mistakes and dead ends in the development of AI, each of which ended in the “winter of AI,” accompanied by disappointment in the potential of this technology. But since the early 2010s, the world has been experiencing a “warming” in the field of AI again. That is why large corporations and governments of leading countries are investing billions of dollars in the development of AI, as it is currently transforming every aspect of our lives, from scientific research to everyday things (Alawi, 2023).

The use of AI in the educational process provides an opportunity to individualise learning, which makes education more effective. This means that programmes can adapt to each student's level and learning style by providing them with individualised tasks and materials. It helps to create personalised learning programmes that take into account strengths, weaknesses, interests, and needs. This contributes to improved learning outcomes and learner motivation, as they are more interested in materials that meet their needs (Flindt et al., 2021).

This research has pinpointed various challenges confronting the field of educational science. Primarily, the matter of safeguarding personal data and ensuring privacy becomes paramount, given that the incorporation of artificial intelligence in education involves the gathering and analysis of personal information. It is imperative to delve deeply into ethical concerns associated with the acquisition and utilization of data in educational practices.

It is important to solve the technical and methodological challenges associated with the introduction of AI in education. Developing programmes and infrastructure for individualised learning requires financial and technical resources. In addition, effective methods for evaluating the success and outcomes of such systems need to be developed (Chen et al., 2020).

The research focuses on the role of AI in individualising learning and developing personalised educational programmes. The main

aspect of the research is to analyse how AI technologies, in particular machine learning and data analytics, can be used to create individualised learning paths (Kumar Basak, Wotto, & Bélanger, 2018).

It addresses the question of how AI can take into account the unique needs and abilities of each individual by providing personalised tasks, materials, and teaching methods. Significant attention is given to the influence of personalized learning on both academic achievements and motivation, highlighting the potential to enhance the overall quality of education through this methodology (Adiguzel et al., 2023).

Particular attention should be paid to ethical and privacy issues related to the collection and processing of students' personal data in the context of personalised educational programmes. In addition, the study focuses on the technical aspects of introducing AI into the educational process and developing methods for assessing the results and effectiveness of individualised learning (Salnyk et al., 2023).

The aim of the study is to thoroughly analyse and define the role of AI in individualising learning and creating personalised educational programmes. Specifically, the study aims at the following objectives:

1) To consider current trends in education that require individualisation of learning and adaptation of curricula to the needs of students and students.
2) Explore how artificial intelligence technologies, such as ML and data analytics, can be used to create individualised learning approaches.
3) To consider the ethical issues related to the use of artificial intelligence in education and the collection of personal data of pupils and students.
4) To study the technical and methodological aspects of implementing individualised AI applications.

Theoretical framework or literature review

Today, the study of artificial intelligence (AI) is becoming an extremely relevant phenomenon in the field of education. This is due to the challenges that have emerged in society in the context of the integration of information technology into various aspects of our lives. Therefore, basic knowledge of AI is becoming a necessity for everyone. The importance of incorporating AI elements into the educational process is now supported at the state level.

In examining the research conducted by Ryan & Deci (2020), it is crucial to highlight their emphasis on applying the connectivity theory within the framework of contemporary educational settings. This theory, rooted in the concept that knowledge should be easily accessible through networks and online resources, has the potential to create fresh possibilities for students, enhancing both their comprehension and practical application of learning materials. The study by Xie et al. (2022) focuses on the impact of social participation on social inclusion. The researchers carefully analyse the relationship between active participation in social interactions and the level of social integration and conclude that this relationship is important. The article by Chen et al. (2020) emphasises the importance of educational big data for modern education. They thoroughly explore methods for extracting meaning from educational data and analysing it further to develop intelligent educational approaches. The work of Cheng & Tsai (2019) is worth noting as significant in the context of using immersive virtual tours in primary school. The authors thoroughly analyse students' learning experiences and teacher-student interaction when using virtual fields for learning, emphasising their effectiveness in the pedagogical process. Cutumisu & Guo's (2019) study focuses on the use of case study methods to extract students' understanding of computational thinking from their own reflections during programming. The authors demonstrate how this method can be useful for analysing students' understandings and their learning. Daniel (2019) provides a critical analysis of issues related to big data and data science for educational research. The researcher discusses current issues and approaches to the use of big data in education. The study by Gierl & Lai (2018) concerns the use of automatic task generation to create solutions and rationales in a computerised format for formative testing. They highlight methods and approaches to creating such tasks. The researchers also point out the importance of current and future challenges and opportunities in the field of artificial intelligence in education, as well as the prospects for the development of this area. This work provides an important contribution to the understanding and development of the use of artificial intelligence in education. Goksel & Bozkurt (2019) in their book focuses on the role of AI in the educational process. They explore the impact of artificial intelligence on contemporary education, presenting a valuable framework for further

exploration in this domain. The researchers' examination of current patterns in the integration of artificial intelligence in education highlights its potential as a crucial element in shaping innovative teaching and assessment methodologies. The study conducted by Hew et al. (2019) prompts a contemplation on the presence of a coherent "theory" within the realm of educational technology research. The authors scrutinize the utilization of conceptual theories in educational technology and assess the existence of well-structured theoretical frameworks. In a study by Huang et al. (2020), the focus shifts towards the prediction of students' academic performance using extensive educational data and the analysis of learning activities. The authors assess various approaches for classifying and scrutinizing learning logs with the aim of forecasting academic achievements.

Insufficiently explored aspects within the realm of educational technology and the utilization of big data encompass several crucial facets demanding increased attention and investigation. Among these, there is a need for the formulation of conceptual and theoretical frameworks to enhance comprehension and elucidation of the impact of big data on learning and education. Existing theoretical approaches, thus far, exhibit limitations and warrant further refinement. Another area that remains under-researched pertains to the ethical considerations surrounding the use of big data in education. Specifically, it is imperative to address issues related to the confidentiality and privacy of student data while establishing ethical parameters governing the collection and utilization of educational data. This is particularly relevant in the context of the growing amount of information collected and processed in educational systems.

Methodology

The research methods used contributed to solving the tasks set by the authors, including analysing the essence of the use of AI in education, which defines the standards in the field of education and science, identifying the main areas of its application, and identifying the problems of implementing AI in the educational environment. The research was conducted using the dialectical method, which was used to analyse AI on both a general and practical basis. This method helps to resolve the issue of the concept of using AI to build individual learning paths, as it contributes to the development of scientific knowledge by moving from concrete to abstract aspects of the problem, abstracting from details. This phase holds considerable importance in the generation of novel scientific insights, achievable through the examination of problem elements and the identification of emerging patterns through abstraction from specific details.

Data from open sources were used to study the dynamics of academic performance. They were obtained through publicly available information resources, such as websites of educational institutions, national education databases, or other documents and reports that are regularly published. In particular, the data on academic performance included average student grades for the 2021/2022 academic year, the dynamics of changes in these grades, as well as other indicators that reflect the qualitative and quantitative aspects of academic performance. The results were evaluated using standard methods of mathematical statistics. The results of the analysis were interpreted with reference to the specific objectives of the study, which allowed us to draw conclusions about the impact of AI on individual learning trajectories and identify possible difficulties in their implementation.

Results and discussion

Today, there are trends in the educational process that require individualisation of learning and adaptation of curricula to the needs of students and pupils. One of them is diversity in learning styles and pace. Each consumer of educational services is unique, and it is important to create curricula that take into account their individual needs and capabilities. This requires appropriate strategies for adaptation and personalisation of learning (Rakhimov, & Mukhamediev, 2022).

Another trend is the growing role of technology in learning. The Internet, mobile applications, and other innovative tools allow for individual learning paths and approaches. Pupils and students can access a variety of learning resources with convenience and efficiency. It is important to take into account the diversity of cultures and languages of popular educational programmes that are freely available online. Globalisation and intercultural interaction create a need to develop intercultural learning and include multilingual pupils and students in educational processes.

In addition, the role of lifelong learning is growing. Rapidly changing technologies and economic realities require continuous learning and retraining. Curricula need to be flexible and individualised to meet these challenges. Contemporary developments in the field of

education emphasize the necessity for personalizing learning experiences and adjusting curricula to enhance the efficiency and advancement of the educational process. Table 1 shows the main trends in the development of modern education.

Table 1.
The main trends in the development of modern education

Education trend	Contents of the main provisions
Individualisation of learning	Contemporary education aims to develop curricula and methodologies that consider the unique requirements of students and their learning speeds. This fosters enhanced and more efficient learning experiences.
Use of technology	The role of technology in learning is growing. The Internet, mobile applications, and online resources allow access to learning from anywhere and at any time.
Intercultural learning	Globalisation creates a need for intercultural learning and the inclusion of different cultures and languages in the educational process. Such approaches promote understanding and respect for diversity.
Lifelong learning	Rapid changes in technology and economic conditions create a need for continuous learning and retraining. Educational programmes are becoming more flexible and accessible throughout life.

Source: Created by the authors based on Ali (2022).

This table provides information on the key trends in modern education and helps to understand how the educational process is adapting to modern challenges. Based on the above, it can be stated that these trends have a significant impact on the requirements for the implementation of AI. Individualised learning implies the unique needs of each student, and in this context, AI can be used to adapt curricula and approaches to meet these needs.

AI is now playing a key role in creating individualised educational trajectories for each pupil and student. It can analyse and process large amounts of data, taking into account individual needs and abilities (Razaulla et al., 2022). By analysing data on learning progress, learning style, pace of learning, and other parameters, AI can recommend personalised learning materials and tasks that meet specific needs. With the help of specialised AI systems, individualised curricula can be created, taking into account the strengths and weaknesses of students, their goals, and interests. Teachers and educators are provided with tools to create unique curricula that help develop individual skills and learning achievements for each student. AI can also provide continuous monitoring of learning progress and adapt programmes in real-time. This helps to avoid pupils and students falling behind or being overwhelmed, ensuring an optimal learning trajectory for each (Luan et al., 2020).

Individualizing the education of pupils and students involves developing distinctive learning methods that consider the unique attributes of each learner. Tasks related to individualization encompass crafting personalized learning plans that consider the strengths, weaknesses, interests, and objectives of students. Additionally, this process involves tracking the progress of learning and adjusting the curriculum as needed (Hendradi et al., 2020).

Individualized instruction empowers educators and educational establishments to more effectively address the requirements of pupils and students, fostering their educational and developmental achievements. It facilitates enhanced and cooperative learning, encourages personal growth, and unleashes the unique potential within each person/

Advancements in technology, exemplified by the utilization of online resources and mobile applications, have facilitated the enhancement of accessibility and interactivity in learning. AI is a pivotal element in this progression. The increasing global intercultural engagement necessitates strategies that acknowledge cultural diversity, and AI emerges as a valuable tool for translating and customizing learning materials to accommodate these diverse cultural contexts. Due to the need for lifelong learning, AI can become an important tool for providing individualised educational opportunities at different stages of personal development.

AI technologies, such as machine learning and data analytics, can be used to create individualised learning approaches due to their ability to analyse large amounts of information and highlight the unique personal characteristics of each student. Machine learning allows special education systems to learn from accumulated data and develop models that predict which

learning approaches work best for each student (Bahri, & Lestari, 2021).

By analysing the data, you can identify the advantages and disadvantages of its users, their individual learning style, the speed of learning, and other parameters necessary to create a favourable learning environment. Based on this data, you can create personalised learning plans that take into account the specific needs and goals of each student.

Learning recommender systems (LRSs) are important tools in the education sector that use machine learning technologies to provide individualised recommendations for learning materials and learning approaches. Their purpose is to enhance the learning experience and enhance the overall quality of education while promoting a more effective utilization of educational resources. The operation of Learning Data Centers (LDCs) relies on analyzing extensive data, including students' learning records, responses to assignments, past advancements, and various parameters. Machine learning allows LDCs to create individualised profiles for each student and anticipate their learning needs (Adjerid & Kelley, 2018). One of the key functions of an LDC is to recommend learning materials that best meet a student's specific needs and goals. For example, the system can recommend specific courses, textbooks, video lectures, or assignments that will help a student improve their knowledge and skills. In addition, LDCs can serve to monitor learning progress and provide students and teachers with information about achievements and possible areas of improvement. They help to create more effective curricula and provide the opportunity to individually tailor learning to the needs of each student and learner (Türkmen, 2023). Table 2 shows the recommendation systems of the main popular MOOC accelerators.

Table 2.
Recommendation systems of the main popular MOOC accelerators

System	Functionality	Paid/free of charge
Coursera	Coursera uses colourimetry algorithms to recommend courses that are similar to courses that the user has already viewed. For example, if a user is watching a course on programming, they may be recommended other courses on programming. Coursera also uses filter-based algorithms to recommend courses that match the user's interests. For example, a user who is interested in machine learning can be recommended courses about machine learning.	Free, paid
edX	edX uses algorithms based on filters to recommend courses that match the user's interests. For example, a user who is interested in business may receive recommendations for courses about business. edX also uses ratings-based algorithms to recommend courses that are highly rated by other users.	Free, paid
Udemy	Udemy uses rating-based algorithms to recommend courses that are highly rated by other users. For example, if a user rates a course highly, they may be recommended other courses that are also highly rated by other users. Udemy also uses algorithms based on user feedback to recommend courses that users are likely to find useful.	Free, paid
LinkedIn Learning	LinkedIn Learning uses algorithms based on career data to recommend courses that may be useful to a user in their professional development. For example, if a user works in the IT industry, they may be recommended courses about IT.	Paid
Khan Academy	Khan Academy uses algorithms based on the user's browsing history to recommend courses that may be useful to the user in their learning process. For example, if a user watches a course on mathematics	Free of charge
YouTube	YouTube uses algorithms based on a user's browsing history to recommend videos that may be of interest to the user. For example, if a user watches a video about programming, other videos about programming may be recommended. YouTube also uses algorithms based on user feedback to recommend videos that users are likely to find useful.	Free of charge
TED-Ed	TED-Ed uses algorithms based on user feedback to recommend videos that users are likely to find useful. For example, if a user rates a video highly, they may be recommended other videos that are also highly rated by other users.	Free of charge

Source: Created by the authors based on Aldowah, Al-Samarraie & Fauzy (2019).

Learning recommender systems have a number of benefits. They can help users find courses that match their preferences and needs. They can also help save time and resources by recommending courses that are likely to be useful. However, learning recommender systems are not without their drawbacks. They may not be as accurate because they are based on data about users' past activity. There is also the possibility of bias, as recommendations may take into account the interests of the majority rather than the individual user (Abed Ibrahim & Fekete, 2019).

These technologies also allow for real-time monitoring of learning progress and adaptation of curricula to meet the needs of each student. They help to create opportunities for more effective and individualised learning, contributing to the success of each student.

When considering the ethical aspects of using AI in education and collecting personal data of students and learners, it becomes clear that there is a need to pay special attention to this issue. On the one hand, the use of AI can greatly facilitate learning by creating individualised learning trajectories and recommendations, but on the other hand, it raises questions about privacy and personal data protection. When AI is used to analyse learning progress, systems often have access to various types of personal information, including academic achievement, learning style, and even emotional state (Niemi, Manhica, Gunnarsson, Stahle, & Larsson, 2019). As a result, this raises questions about who has access to this data and how it will be used. It is also important to consider the bias and relevance of the recommendations provided by the AI. If the system is based on other users' data, it may result in recommendations that take into account the interests of the majority rather than the individual needs of each pupil or student (Alzain, 2019).

When considering the technical aspects of implementing personalised programmes using AI in education, it is important to examine the technological infrastructure. This includes researching the available platforms, software, and hardware that can be used to create and run personalised learning programmes. Technical aspects also include data collection and processing. Effective personalised learning requires the collection and analysis of a large amount of data about each learner or student. The study should include an analysis of how this data is collected and stored, as well as its security and privacy.

They require consideration of how to integrate personalised programmes with existing educational platforms and systems. How do these new solutions interact with other components of education, and how can individualised programmes be made to work seamlessly within the wider context of learning? Analysing the technical aspects of implementing individualised learning programmes using artificial intelligence requires studying the technological capabilities, data collection and processing tools, and integration aspects for the effective implementation of these programmes in the educational sphere.

This study has practical and theoretical implications that are important for the further development of education and the use of technology in learning. Practical implications include the possibility of creating and implementing individualised curricula that can adapt to the needs of each pupil or student. This can improve the quality of learning and ensure greater student success in the learning process. Practical implications also include the identification of optimal technical solutions for the implementation of individualised programmes, which will help educational institutions and teachers find the most effective ways to apply artificial intelligence. The theoretical implications are to broaden the understanding of how AI technologies can be used in education. This helps to improve theoretical models of learning and develop new approaches to individualised learning. Also, this research can contribute to the development of ethical standards and policies for the protection of personal data in education, which is of important theoretical importance.

Conclusions

This study has thoroughly analysed the technical and methodological aspects of implementing individualised learning programmes using AI in the educational process. The findings emphasise the importance and potential of such programmes for the further development of education.

The study's technical dimensions suggest that existing technologies and platforms provide the capability to develop personalized programs customized to the requirements of every student. It is crucial to investigate how these technical solutions can be integrated into the educational process and assess their compatibility with established MOOCs.

Methodological considerations highlight the importance of examining how to recognize the requirements and capabilities of each learner, as well as developing a methodology to assess the effectiveness of personalized programs. Taking into account different learning approaches, age, and individual characteristics of each student, it is important to develop a methodology that would help achieve the best results. From a practical perspective, the introduction of individualised learning programmes using AI can improve the quality of learning and help each student achieve greater academic success. However, it is also important to consider ethical issues and protect users' personal data.

The study found that individualised programmes create more incentives for students through a personalised approach to learning. The introduction of such programmes can help increase students' motivation and engagement in learning. It is noted that individualised programmes allow more accurate consideration of individual needs and level of learning for each student. Attention is focused on the fact that individualised programmes allow students to receive personalised support according to their specific challenges and strengths. This can lead to more effective training and skill development. Overall, the study emphasises the importance of individualised programmes in modern education and points to the potential of artificial intelligence to achieve this goal. Taking into account technical and methodological aspects, effective individualised curricula can be developed that meet the needs of each pupil and student.

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