
INNOVATIONS IN EDUCATION AS THE BASIS OF SUSTAINABLE DEVELOPMENT

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Abstract: The main goal of this work is to demonstrate the importance of incorporating innovation in education as a crucial aspect of sustainable development. Education is a fundamental right for all individuals and plays a vital role in their development. The continual acquisition and dissemination of knowledge, driven by advancements in science and practical achievements, are essential for sustainable development. It serves as a valuable framework for achieving economic, social, and ecological progress in national economies. The author's objective is to integrate various theoretical concepts of innovation in education, particularly those related to artificial intelligence, with a focus on Chat GPT. The paper also examines the positive and negative implications of using these innovations. Empirical research was conducted on a sample of 124 undergraduates and master's students, using primary data sources. The data were analyzed using descriptive statistics, frequency analysis, and the Mann-Whitney U test. The findings indicate that a significant percentage of students utilize Chat GPT, not only for writing papers but also for generating new knowledge. The use of Chat GPT varies based on the respondents' level of study and gender. This study's results can contribute to identify areas in education that require innovation and potential strategies for motivating students to utilize artificial intelligence in generating new knowledge.

Keywords: innovation in education, sustainable development, Chat GTP

1. INTRODUCTION

The emergence of artificial intelligence (AI) has created revolutionary possibilities that have forever changed our understanding of the world and our place within it. AI has quickly been applied in various fields, including education, as it is essential to equip individuals with the necessary knowledge, skills and abilities to keep up with the constantly evolving landscape of innovation. However, there is no single definition of AI in the literature due to different approaches. For the purposes of this text, the following definition will be used: "*Artificial intelligence refers to systems that use technologies such as text mining, computer vision, speech recognition, natural language generation, machine learning, and deep learning to gather and/or use data to predict, recommend, or decide, with varying levels of autonomy, the best action to achieve specific goals*" (Samoili et al., 2020). As such, the potential applications of AI are vast and can be utilized in all sectors, including economic and non-economic, at both macro and micro levels. In the field of education, the implementation of AI has led to various innovations, as outlined by Huang et al. (2021), including adaptive learning, teaching evaluation, virtual classrooms, smart campuses and intelligent tutoring robots (pp. 207-210).

In November 2022, OpenAI CEO Sam Altman caused a public sensation by presenting the latest Chat GPT model 4. The first model was created in 2018 years, and since then it has been continuously innovated. The result was the creation of GPT-2 (2019) and GPT-3 (2020). The improved version of Chat GPT-4 quickly showed superior performance. Chat GPT is an AI chatbot capable of generating human-like detailed responses to human prompts (Wu, 2023: 1122). The application of Chat GPT in education is necessary to understand its appropriateness for all stakeholders, including professors, students and administration, in order to increase the efficiency and effectiveness of learning. While most approaches focus on either teacher-centered or student-centered learning (Candrasari et al., 2024) the implementation of Chat GPT can simplify a number of administrative tasks, saving time and reducing the workload of administrative staff and managers.

The use of ChatGPT has both positive and negative aspects. Some of the most commonly mentioned positive aspects include: 1. Lesson planning: Chat GPT can be utilized to enhance lesson plans by creating engaging activities, illustrations, and exercises for students. 2. Personalized learning: Professors can tailor activities to each student's abilities, potential, and needs. 3. Quick and accurate answers: Chat GPT can provide accurate answers to difficult questions in any subject area. 4. Automatic grading: Chat GPT can be used to quickly grade assignments and quizzes, providing student results in a timely manner. 5. Homework help: Chat GPT offers assistance with homework, essays, stories, poems, and more, while also encouraging students to improve their writing skills. 6. Language learning: The robot's ability to translate, create sentences, and explain grammatical rules make it a valuable tool for language learning. 7. Brainstorming and creativity: Students can use Chat GPT to exchange ideas for essays, projects, and creative writing, as well as generate content. 8. Test preparation:

Chat GPT can assist students in preparing for tests by answering questions, providing study tips, and offering test-taking help. 9. Accessibility: Chat GPT provides support for students with disabilities in various learning activities. 10. 24/7 availability: Chat GPT is available 24 hours a day, making it a convenient resource for students. 11. Interactive Learning Assistant – is based on an interactive teacher-student relationship in which the teacher directs the student to appropriate literature, monitors their progress, and based on that suggests strategies for improving knowledge (Rahman & Watanobe Y., 2023; Kathiravan et al., 2024).

Possible disadvantages of using Chat GPT include: 1. Lack of Human Interaction: One potential drawback of using Chat GPT is the lack of human interaction. As an AI-powered chatbot, Chat GPT may not be able to provide the same level of personal connection and support as a human teacher or tutor. This could be especially problematic for students who thrive on face-to-face interactions and may struggle with virtual learning environments. 2. Limited Understanding: Another issue that may arise when using Chat GPT is its limited understanding. While the chatbot may be able to answer basic questions, it may struggle with more complex inquiries that require a deeper understanding of a student's individual needs and misconceptions. This could lead to frustration and confusion for students who are seeking personalized support. 3. Lack of Creativity: As an AI program, Chat GPT may also lack creativity and the ability to think outside of the box. This could limit its effectiveness in providing engaging and dynamic learning experiences for students. Without the ability to adapt and be creative, Chat GPT may struggle to keep students engaged and motivated. 4. Dependency on Data: Chat GPT's performance is heavily reliant on the quality and quantity of data it has been trained on. This means that if the data are limited or of poor quality, the chatbot may not be able to provide accurate or helpful responses. This could be a significant disadvantage for students who are relying on Chat GPT for their learning. 5. Limited Ability to Personalize Instruction: While Chat GPT may be able to provide generalized data, it may struggle to respond to personalized user requests. This could be a problem for students who have specific learning needs or require individualized instruction. Without the ability to personalize instruction, Chat GPT may not be as effective as a human teacher or tutor. 6. Plagiarism: Finally, there is a risk of plagiarism when using Chat GPT. If students rely solely on the text generated by the chatbot without consulting additional sources or seeking out different opinions, they may unintentionally plagiarize. This could have serious consequences for their academic integrity and learning.

Modern society, as well as individuals, have only recently begun to pay attention to the consumption and depletion of natural resources. This behavior has had consequences for the planet, including the development of technologies, industrialization, globalization, the creation of a consumer society, mass production and consumption, and the way of life for people. These factors have led to environmental devastation and a negative impact on all aspects of human life (Milanović & Eric, 2024). According to Boeve-de Pauw et al. (2015), “the drivers of sustainability problems are rarely the result of direct malicious intent”, but rather a chain reaction of interconnected factors. Unsustainable practices are evident in the fast-paced lifestyle driven by human insatiability, the easy availability of products due to mass production and consumption, and the short life cycle of products (Milanović & Erić, 2024a). This has resulted in increased pressure on the environment, scarcity of resources due to inefficient use, and a growing demand that has made “the current standard of living unsustainable” (Milanović, Erić, Petković, & Grdinić, 2023).

The issue of sustainable development is highly relevant as it involves finding solutions to maintain and preserve the natural environment and resources of the planet while also promoting the well-being and growth of the population. This concept, as defined by Boeve-de Pauw et al. (2015) is known as sustainable development. The Brundtland Commission has established a widely accepted definition, stating that sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (WCED, 1987:5). To achieve this, it is necessary to consider and balance three dimensions: economic, ecological, and social (Boeve-de Pauw et al., 2015; Summers & Childs, 2007).

Sustainable development is a model of behavior that emphasizes responsible use of resources by current generations for the benefit of future generations. It is crucial for all generations to continuously learn and develop an understanding of the importance of a healthy environment. One of the key goals of sustainable development, as defined by the United Nations (UN, 2016), is to provide quality education. Education is a necessary prerequisite for successful development (Filipović, 2019) and is closely linked to sustainable development (Hopkins & McKeown, 2002). Therefore, it is essential to implement effective educational strategies in order to achieve optimal levels of sustainable development (Milanović & Erić, 2024a; Filipović, 2019). The development of innovative approaches in this area can accelerate the application and potential for improving the quality of education and training, ultimately leading to increased awareness among individuals and creating a “movement towards sustainability” in society (Hopkins & McKeown, 2002). Education plays a crucial role in sustainable development by equipping individuals with the knowledge and skills to implement its principles and goals (Marouli, 2016).

The use of Chat GPT has already been shown to contribute to achieving certain goals of sustainable development (Wang et al., 2023). In this sense, it is important for students to be familiar with the Interactive Learning Assistant, Personalized Learning, and Learning Assessability. By mastering these tools, as well as other knowledge listed as advantages of using

Chat GPT, students can apply them to achieve other sustainable development goals. These goals include: 1. Good health and well-being; 2. Clean water and sanitation; 3. Affordable and clean energy; 4. Sustainable cities and communities; 5. Climate action; 6. Decent work and economic growth; 7. Industry, innovation and infrastructure; 8. Responsible consumption and production. Therefore, the use of Chat GPT can contribute to achieve nine out of the 17 sustainable development goals. As a result, it can be confidently stated that innovations in education, specifically through the use of Chat GPT, are a significant factor in promoting sustainable development.

2. MATERIALS AND METHODS

The methodology used in this work is based on the utilization of secondary data sources, which were used to develop empirical research. When discussing secondary (theoretical) sources of data, the methods of analysis and synthesis, induction and deduction, abstraction and generalization, and comparison were employed as logical-empirical procedures. An empirical investigation was conducted in Serbia by collecting, processing, and analyzing data from a random sample of 124 students from the Belgrade Business and Arts Academy of Applied Studies between April 2024 and August 2024. The frequency of responses to the question "Do you use Chat GPT?" was determined using a Likert-type scale with answers ranging from 1 to 3, where are: 1 - "Do not use Chat GPT", 2 - "Rarely use Chat GPT" and 3 - "Frequently use Chat GPT." Attitudes towards using Chat GPT were measured using a modified research instrument (Siregar, F. H, 2023: 634) with a Likert-type scale ranging from 1 to 3. Each answer on the scale indicates the following: 1 - "I disagree", 2 — "Agree" and 3 — "Strongly agree."

Quantitative analysis of the obtained data was performed using the Statistical Package for Social Science (SPSS) Descriptive statistics, frequency analysis, and the Mann-Whitney U test were applied. The results and discussion are presented in the following section. Following everything previously stated regarding the objectives and subject of the research, the following hypotheses were set:

H1: Most respondents use Chat GPT.

H2: Respondents have positive experiences about the dimensions of use Chat GPT.

H3: There is a statistically significant difference in the use Chat GPT according to gender and level of education.

3. RESULTS

Table 1 displays the descriptive statistics and usage Chat GPT for the sample of respondents. The majority of the random sample is female, accounting for 54%, while males make up 46% of the sample. The largest portion of respondents are undergraduate students, making up 51.6% of the sample, while the remaining 48.4% are master's students. It is worth noting that 12.1% of respondents do not use Chat GTP, while 49.2% rarely use it and 38.7% use it frequently. Overall, we can conclude that the first hypothesis has been proven, as 109 respondents (87.9% of the valid percentage) use Chat GTP to a greater or lesser extent.

Table 1. Descriptive statistics and using Chat GPT of the sample

Variable	Frequency	Percent	Valid Percent
Gender			
female	67	54,0	54,0
male	57	46,0	46,0
Total	124	100	100
Education			
undergraduate	64	51,6	51,6
master	60	48,4	48,4
Total	124	100	100
Using of Cht GPT			
Don't use Chat GPT	15	12,1	12,1
Rarely use of Chat GPT	61	49,2	49,2
Frecvently use Chat GPT	48	38,7	38,7
Total	124	100	100

Source: Calculation of authors

The second hypothesis has been proven, as evidenced by the results of the frequency analysis in Table 2. Respondents reported positive experiences with the various dimensions of using Chat GPT. The highest level of satisfaction was found

in its use, with 95.1% of respondents expressing satisfaction. Additionally, 82.3% of respondents noted its powerful capabilities, 79.8% reported that it often provides correct answers, 78.2% found its explanations impressive, and 76.6% appreciated its well-structured answers. While the remaining dimensions also received high scores, they were slightly lower. 75.8% of respondents perceived Chat GPT as a positive tool for learning, 69.3% found it helpful in studying more efficiently, and 74.2% noted its ease of use.

Table 2. Perception of respondents about dimensions of Ghat GPT based on frequency analysis

Variable	Item Code	Questions	I disagree	Agree	Strongly agree
			Frequency (Percent)	Frequency (Percent)	Frequency (Percent)
The use of Chat GPT (USE)	USE1	Do you agree that Chat GPT has powerful capabilities?	22 (17,7%)	61 (49,2%)	41 (33,1%)
	USE2	Do you agree that Chat GPT is an effective tool for learning?	30 (24,2%)	47 (37,9%)	47 (37,9%)
	USE3	Do you agree that Chat GPT is a complementary for learning resource?	6 (4,8%)	63 (42,7%)	65 (52,4%)
	USE4	Do you agree that Chat GPT helps to study more efficiently?	38 (30,6%)	48 (38,7%)	38 (30,6%)
	USE5	Do you agree that Chat GPT is easy to use?	32 (25,8%)	52 (41,9%)	40 (32,3%)
	USE6	Do you agree that Chat GPT presents an impressive explanation?	27 (21,8%)	62 (50,0%)	35 (28,2%)
	USE7	Do you agree that Chat GPT provides well-structured answers?	29 (23,4%)	58 (46,8%)	37 (29,8%)
	USE8	Do you agree that Chat GPT usually answers the question correctly?	25 (20,2%)	52 (41,9%)	47 (37,9%)

Source: Calculation of authors

The third hypothesis was fully proven using the Mann-Whitney U test. The hypothesis was strongly supported, and the results are shown in Table 3 and Table 4. There is a statistically significant difference in the use of Chat GPT according to gender and level of education. This is supported by a p-value of 0.000, which is lower than 0.05 for gender and by p-value of 0.000 for education. The Mann-Whitney U value is 429,000 and $Z = -7,501$ for education. Master students have a more pronounced level in the use of Chat GPT, with a mean rank of 87,35. The Mann-Whitney U value is 1153,500 and $Z = -3,814$ for gender. It implies that male have higher level in the use of Chat GPT, with a mean rank of 75,76.

Table 3. Ranks of using Chat GPT according to education and gender

	Variable	N	Mean Rank	Sum of Ranks
Using GTP	Education			
	undergraduate	64	39,20	2509,00
	master	60	87,35	5241,00
	Total	124		
	Gender			
	female	67	51,22	3431,50
	male	57	75,76	4318,50
	Total	124		

Source: Calculation of authors

Table 4. Test statistic for education and gender

Test Statistics^{aB}		
	Using GTP	
Mann-Whitney U	429,000	1153,500
Wilcoxon W	2509,000	3431,500
Z	-7,501	-3,814
Asymp. Sig. (2-tailed)	,000	,000
Grouping Variable:	a. Education	b. Gender

Source: Calculation of authors

4. DISCUSSION

The paper explores the causal relationship between innovations in education, specifically the implementation of ChatGPT and sustainable development. This study is groundbreaking in Serbia and lays the foundation for further theoretical and practical research. The main finding is that the implementation of ChatGPT has the potential to enhance the educational system in Serbia. This is supported by statistically significant usage of ChatGPT by students in Serbia, as demonstrated in previous studies conducted around the world (Siregar et al., 2023; Shoufan, A., 2023; Valova et al., 2024; Sila et al., 2023). The perceptions of students in Serbia regarding all aspects of using ChatGPT are overwhelmingly positive, particularly as a supplementary learning tool with advanced capabilities and the ability to provide accurate answers. Other studies have also reported high levels of positivity in all aspects of using ChatGPT (Siregar, F. H., 2023; Shoufan, A., 2023; Romero-Rodríguez et al., 2023), while some have specifically highlighted the positive impact of certain aspects (Giray, 2024; Yilmaz et al., 2024).

Sustainable development, which originated in research in 1987 and integrated economic, social, and environmental components, is more relevant today than ever before. The inefficient use and waste of resources have made our "current standard of living unsustainable", as reflected in the definition of the 17 goals of sustainable development. Achieving these goals is crucial for improving the lives of future generations. Innovations in education, such as the use of ChatGPT, can contribute to achieving one of these goals: a better quality of education. While ChatGPT has its drawbacks, its application can lead to optimized lectures, improved student knowledge, and better interaction between professors and students. Additionally, the paper demonstrates how the use of ChatGPT can contribute to achieving nine of the sustainable development goals and overall sustainable development (Wang et al., 2023; Raman et al., 2024; Bhaskar, 2025). However, it is important to note that the main issue with using ChatGPT is its potential environmental impact, specifically in terms of increased carbon emissions.

There are several limitations to the application of ChatGPT in Serbia. Firstly, according to the World Bank's ranking, Serbia is one of the ten poorest countries in Europe (<https://wisevoter.com/country-rankings/poorest-countries-in-europe/>) with a poverty or social exclusion rate of 28.1% and a permanent poverty risk rate of 12.9% (<https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=RS&view>). This means that many students do not have access to computers or the internet. While being poor is nothing to be ashamed of, many people are hesitant to admit the truth. Additionally, not all students in our school system have their own computers, which leads to long wait times for access to a free computer. Another limitation is the lack of knowledge among both professors and students about the capabilities, limitations, and proper usage of ChatGPT.

Based on the text, it appears that the research sample is limited to business students, which may not accurately represent the larger population. To improve the quality of future research, it is recommended to expand the sample size and include students from various disciplines. This will provide a more diverse perspective and increase the generalizability of the findings. Additionally, incorporating students from different countries in the region would allow for a more comprehensive comparative analysis of national economies. A practical suggestion for future research would be to offer training sessions for both professors and students on how to effectively utilize ChatGPT. This would ensure that all participants have a thorough understanding of the tool and can use it to its full potential. However, it is important to use ChatGPT with caution, as it may have limitations such as providing delayed responses and lacking the ability to think like a human mind. These potential drawbacks should be taken into consideration when interpreting the results of the research.

5. CONCLUSION

The concept of artificial intelligence (AI) has been present in all industries, services, and the public sector for a long time. One of the most prominent AI products is Chat GPT, which is just one of many products that use multimodal learning. The latest model, GTP-4, has opened up new possibilities for use and has sparked the interest of researchers and business people. As a result, more and more organizations are trying to develop their own models based on Chat GPT. This paper focuses on the impact of ChatGTP on education and its role in achieving the goal of sustainable development, specifically in providing quality education. To do so, an extensive review of theoretical literature and empirical research was conducted. However, despite the digital literacy of the modern generation, the latest model GTP-4 is not widely used in our country due to economic reasons. Additionally, the educational system is not able to incorporate the use of this model due to structural and strategic limitations. It is crucial to ensure quality education as one of the goals of sustainable development for the economic, social, and technological development of Serbia. The results of this study can contribute to identifying areas in education that need innovation and finding ways to motivate students to use Chat GPT to generate new knowledge that aligns with the needs of the labor market. This can only be achieved through collaboration between scientific institutions, business organizations, and the state, which can lead to high-quality incremental or radical innovations that will boost the development of our national economy.

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