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RESEARCH ARTICLE

A Conversation with ChatGPT about the Impact of the COVID-19 Pandemic on Education: Comparative Review Based on Human–AI Collaboration

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ABSTRACT

Background/purpose – ChatGPT, an AI-powered chatbot designed with generative pre-trained transformer architecture, have intrigued millions of people from diverse backgrounds since its first release, and generated excitement with its groundbreaking performance in numerous use cases they have been tested. Its ability to generate coherent and contextually relevant responses across a wide range of topics have also attracted the attention of researchers, and several scholars have investigated the potential uses of this AI-based tool to promote scientific work. The current study was designed with a similar purpose, and aimed to conduct scientific research on the effects of COVID-19 pandemic on education with a collaborative analysis of human-artificial intelligence.

Materials/methods – The data were generated from simultaneous interviews with ChatGPT-3.5 and 4, and their responses were evaluated comparatively in terms of the accuracy, clarity, conciseness, and breadth of information provided for (1) the definition of the COVID-19 pandemic, (2) the negative impact of the COVID-19 pandemic on education, (3) the positive impact of the COVID-19 pandemic on education, (4) recommendations to improve the effectiveness of teaching and learning during the COVID-19 pandemic. We evaluated the responses using a trichotomous rating system, and also calculated Cohen’s kappa values to assess inter-rater agreements for each category of evaluation.

Results – The results indicated that both versions demonstrated a strong potential to generate accurate, clear and concise information with a satisfactory breadth. As can be expected, ChatGPT-4 provided more categorized and synthesized information, and was better at demonstrating critical reasoning.

Conclusion – These results indicate that ChatGPT is a promising tool that can support scientific research process in collaboration with human intelligence, and its newer versions could be developed in a way that these chatbots could be ethically and safely integrated into different stages of scientific work.

Keywords – ChatGPT, COVID-19 pandemic, artificial intelligence, global health crisis, education, chatbot, OpenAI.

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1. INTRODUCTION

ChatGPT, an artificial intelligence-based large language model (LLM), was released on November 30, 2022 to receive feedback on its strengths and weaknesses based on user experiences (OpenAI, 2022). It garnered so much interest that it reached more than one million users on the very first days of its release (Vallance, 2022). ChatGPT has been trained with terabytes of data (Willems, 2023), which makes it capable of generating natural, human-like responses to the questions posed by its users in a matter of seconds, (Shah, 2002) as well as performing complex tasks, enabling easier access to information (Saliba & Boitsios, 2023), understanding questions asked in multiple languages and responding to these questions in the language used with perfect grammatical accuracy. These features of ChatGPT results from its deep learning algorithm (Min et al., 2021; Shen et al., 2023; Tülübaş et al., 2023), which enables it to generate new content by processing existing data (Go-zalo Brizuela & Garrido-Merchan, 2023).

In the educational literature, several benefits of ChatGPT have already been articulated such as developing students' writing skills both in the native and second language (Stokel-Walker, 2022; Karakose, 2023), helping students studying in the field of software to write codes in several programming languages (Castelvecchi, 2022), facilitating access to information (Stokel-Walker, 2022), guiding language learning and development with the ability to understand the nuances of the language and to establish almost human-like communication (Carvalho, & Ivanov, 2023). However, some concerns have also been arisen about the use of ChatGPT such as its potential to make cheating easier particularly in online exams (Oppenheimer, 2023), weaker reliability in factual information it provides (Zhuo et al., 2023), and lack of built-in mechanisms to identify the reliability of responses (Chui et al., 2022). In addition to these concerns, ChatGPT's current inability to question further when the prompts used are ambiguous (OpenAI, 2022), focusing on plausibility rather than accuracy (Delouya, 2022), and lack of clarity about where the information was obtained from are also listed among its negative aspects. As a result, in its current state, ChatGPT users are to verify the outputs obtained from this chatbot using other, more reliable information sources (Chui et al., 2022; Karakose et al., 2023; van Dis et al., 2023).

While the number of studies on the scientific use of ChatGPT is gradually increasing in the literature, studies on its use in the context of educational research is still limited. Considering this gap, the current study aims to conduct a research process based on human-artificial intelligence collaboration using ChatGPT-3.5 and ChatGPT-4 as two alternative versions of artificial intelligence. The research process particularly focuses on the impact of the COVID-19 global health crisis on education, and thus, evaluates the capacity of ChatGPT to support scientific research with regard to providing informative and reliable information about this recent topic of interest. In fact, the impact of the COVID-19 pandemic on education worldwide was considered to be a suitable topic for a human-artificial intelligence collaborative analysis as its understanding requires both theoretical knowledge and critical reasoning. In addition, within the scope of this study, the ability of ChatGPT-3.5 and ChatGPT-4 to produce accurate, clear, concise information with satisfactory breadth was comparatively assessed so as to identify its current status as well as evaluating the future prospects of using such AI-based tools in educational research.

1.1. COVID-19 Pandemic and Its Impact on Education

Coronavirus (COVID-19), which was detected in Wuhan city of Hubei province of China at the end of 2019, caused a global health crisis that raised concerns and fear all over the world in a short time (Huang et al. 2020; Wang et al., 2020). Due to the fast transmission of this deadly-disease from person to person and the absence of a definite drug treatment in the early stages of the pandemic, this health crisis forced governments all over the world to take drastic measures (Sadjadi, 2023). In fact, the world had faced infectious and deadly global health threats such as avian influenza, MERS, SARS and Ebola prior to the COVID-19 disease. However, the social, cultural, political and economic impact of these epidemics lagged far behind the COVID-19 pandemic (Bratianu & Bejinaru, 2020; Yirci & Ozdemir, 2021). With the COVID-19 pandemic, almost all states around the world experienced great difficulties in managing the outcomes of this difficult and complex disaster (Filip et al., 2022).

During the initial stages of the crises, travel bans were imposed in order to prevent the spread of the COVID-19 disease, face-to-face education was suspended partially or completely, strict social distance rules were introduced, and wearing masks in public places became mandatory (Hume et al., 2022; Karakose et al., 2022). All these severe measures changed people's routines and employees with diverse occupations had to work from home (Segev-Jacobovski 2023). It was certainly not easy for people to adapt to these drastic changes in their lives (Sacco & Domenico, 2021). In addition, the COVID-19 pandemic put a great deal of pressure on the capacities of health systems, particularly during the early stages. The inadequacy or sometimes the lack of buildings, health-care workers, and medical care equipment in hospitals increased the workload of health workers (Winkelmann et al., 2022; Adatara et al., 2023; Karakose et al., 2021; Kim et al., 2023). With all these outcomes, the COVID-19 pandemic has become one of the most difficult crises faced by humanity in modern history (Karakose, 2021).

The COVID-19 pandemic has had serious pressures and effects on education systems as well as healthcare. According to World Bank data, schools in all grades suspended education in more than 180 countries, and approximately 95% of the total student population worldwide was affected by school closures (Azevedo et al., 2021; Betthäuser et al., 2023). Innovative online education and training methods were quickly implemented in order to compensate for the learning losses of students during the prevention and control of COVID-19. In education, teachers and students gathered in internet-supported virtual classrooms, and the education was sustained via online learning and distance education (Cui et al., 2023). Traditional face-to-face lessons with a higher potential for teacher-student interaction were rapidly and perforce replaced by lessons in the digital classroom environments due to social distance measures taken to prevent the spread of the disease (Garcez, Silva & Franco, 2022). Although this model of education also called 'emergency remote teaching (ERT)' provided the continuity of education, it brought with it adaptation problems for students, teachers and parents. On the other hand, this process of ERT also highlighted the need for developing teachers' digital literacy skills and promoting their continuous professional development with this regard (Eringsfeld, 2021). Many problems such as the ineffective functioning of the internet and network infrastructure for online courses, the inadequacy of digital education resources, and communication problems in distance education revealed the disadvantageous aspects of ERT. School closures and lockdown measures also restricted students' social interaction with their peers, and suspended extracurricular social activities, which are significant in the holistic development of students. In addition to all these negative impacts,

the physical and mental health of individuals were also adversely affected during the pandemic (Sriram et al., 2023). The environment of social and economic uncertainty caused by the COVID-19 pandemic also had adverse effects on the relationships within the family. These negativities were felt even more significantly by students with low socio-economic background (Betthäuser et al., 2023; Karakose, 2021b; Schuurman et al., 2023).

The COVID-19 pandemic has suggested important implications for sustaining education in the event of a comprehensive global crisis and shed light on problems solved way before they are encountered the next time. Many problems with regard to curriculum, compensating learning losses, online instructions, experiential learning in virtual environments, restricted technology infrastructure such as insufficient internet connection or the unavailability of necessary digital tools, measurement and evaluation, and social justice have become areas of significant focus for educators and policy makers (Tang, 2023). During the COVID-19 pandemic, teachers and educational administrators unfortunately received insufficient support for ensuring the continuation of distance education activities, promoting the mental well-being of students, and improving their digital competencies. Therefore, a detailed examination of the COVID-19 global health crisis with its effects on education around the world, and the analysis of the problems experienced by various parties would help devising solution-oriented initiatives that can guide the better management of similar global crises in the future.

2. METHODOLOGY

The current study aimed to conduct a research process to investigate the impact of the COVID-19 global health crisis on education based on a collaborative analysis of human intelligence and artificial intelligence. The study was particularly designed to comparatively evaluate the performance of ChatGPT-3.5 and ChatGPT-4 in generating accurate and reliable information that could help promote scientific research process.

In line with this purpose, we first prepared a set of questions to be asked simultaneously to ChatGPT-3.5 and Chat-GPT 4 to receive responses under four categories: (1) the definition of the COVID-19 pandemic, (2) the negative impact of the COVID-19 pandemic on education, (3) the positive impact of the COVID-19 pandemic on education, (4) recommendations to improve the effectiveness of teaching and learning during the COVID-19 pandemic. These categories and relevant questions were devised after a careful review of literature on the effect of COVID-19 on education worldwide, and the final set of questions and categories were reached after a discussion panel with the participation of six researchers. In the same panel, we also developed a trichotomous rating system to evaluate the quality of information provided by each version of ChatGPT in terms of its accuracy, clarity, conciseness, and breadth. According to this rating system, a point of 3 indicated a high level of accuracy/clarity/conciseness/breadth while 2 indicated a moderate level of accuracy/clarity/conciseness/breadth. A point of 1, on the other hand, indicated low level of accuracy/ clarity/conciseness/breadth.

We also evaluated the inter-rater agreement on the responses generated by each version of ChatGPT using the values given by two random raters for each category of query mentioned above. Cohen's kappa is a reliable and effective assessment method as a chance-corrected evaluation of inter-rater agreement on a nominal scale (Warren, 2015), and makes it possible to assess if the degree of agreement occurred by chance or for real (Sun, 2011). Cohen's kappa is acknowledged in social and medical sciences as a robust statistic whose results are reliable to evaluate the quality of information based on the ratings of two raters

(Viera et al., 2010). In the current study, the Cohen's kappa value for each category of query was calculated on the SPSS - version 26. The values obtained from this analysis is interpreted based on the benchmark developed by Landis and Koch (1977). According to this benchmark, a kappa value between 0.00 and 0.20 indicates slight inter-rater agreement while a kappa value between 0.21 and 0.40 indicates fair agreement. A kappa value between 0.41 and 0.60 indicates a moderate agreement, a value between 0.61 and 0.80 indicates strong agreement, and a kappa value between 0.81 and 1.00 indicates that there is almost perfect agreement between the raters.

3. RESULTS


This section presents the comparative analysis of the responses generated by ChatGPT-3.5 and ChatGPT-4 for our queries on (1) the definition of the COVID-19 pandemic, (2) the negative impact of the COVID-19 pandemic on education, (3) the positive impact of the COVID-19 pandemic on education, (4) recommendations to improve the effectiveness of teaching and learning during the COVID-19 pandemic. To ensure transparency, some of the responses from both versions of ChatGPT are presented in figures before detailing the evaluation of results based on our trichotomous rating system for accuracy, clarity, conciseness, and bias possibility of the information provided in these responses.

Our first query on ChatGPT started with 'the definition of the COVID-19 pandemic' and sample snapshots of ChatGPT's responses are illustrated in Figure 1.

RESEARCH THEME: The Definition of COVID-19 pandemic

Model: GPT-3.5

 TY What is the COVID-19 pandemic?

 The COVID-19 pandemic is an ongoing global outbreak of respiratory illness caused by a novel coronavirus, called SARS-CoV-2. The outbreak was first identified in Wuhan, China in December 2019 and has since spread to become a worldwide pandemic, affecting millions of people in virtually every country.

The virus is primarily spread through respiratory droplets generated when an infected person talks, coughs, or sneezes. Common symptoms of COVID-19 include fever, cough, and difficulty breathing, but many infected people have no symptoms or only mild symptoms. However, the virus can cause severe illness and even death, particularly in older adults and people with underlying health conditions.

To slow the spread of the virus, many countries have implemented public health measures such as social distancing, mask-wearing, and lockdowns. Vaccines have also been developed and are being distributed to protect people against the virus.

 Regenerate response

 Model: GPT-4

TU What is the COVID-19 pandemic?



The COVID-19 pandemic is a global health crisis caused by the novel coronavirus, SARS-CoV-2. The virus was first identified in December 2019 in Wuhan, Hubei Province, China, and has since spread rapidly across the world, affecting millions of people. COVID-19, which stands for "coronavirus disease 2019," causes respiratory illness with symptoms ranging from mild flu-like symptoms to severe pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ failure in some cases. The pandemic has had significant social, economic, and public health consequences, leading to lockdowns, travel restrictions, and widespread changes in daily life. Efforts to combat the pandemic have included widespread testing, contact tracing, quarantine measures, and the rapid development and distribution of vaccines.

Figure 1. Sample snapshots from the responses of ChatGPT-3.5 & ChatGPT-4 for the definition of COVID-19 pandemic (generated on April, 16, 2023)

Both ChatGPT-3.5 and ChatGPT-4 stated that the COVID-19 pandemic was caused by the Coronavirus named SARS-CoV-2. However, ChatGPT-3.5 described COVID-19 as a global respiratory disease while ChatGPT-4 described it as a global health crisis. In addition, ChatGPT-3.5 stated that the epidemic started in Wuhan, China in December 2019 and spread to the world, while ChatGPT-4 gave more specific information by emphasizing the Hubei province, where the city of Wuhan is located.

While the responses by ChatGPT-3.5 included information about the symptoms of the virus, ChatGPT-4 presented this in a more detailed and comprehensive way. The responses generated by ChatGPT-3.5 focused on the places where the virus more easily spread, the people most likely to be vulnerable to its deadly-effects, and the measures taken by countries to prevent the spread of the virus, ChatGPT-4 added to this information the origin of the name COVID-19, the social and economic consequences of the epidemic on countries and people.

To evaluate the information provided for this category of query, we calculated the average values of ratings given by each researcher in terms of accuracy, clarity, conciseness, and breadth of information. The average values for the responses by ChatGPT-3.5 were 2.83, 2.16, 2.50, and 2.16 respectively. As for the responses by ChatGPT-4, the average values were 3, 2.67, 2.83, and 2.83 respectively. Based on these results, it can be stated that both versions were capable of defining the COVID-19 pandemic with accurate, clear, and concise information. However, it was also evident that ChatGPT were able to generate more comprehensive response, with a better breadth of information.

The Cohen's kappa values were calculated to evaluate the inter-rater agreement on the quality of responses generated by both versions of ChatGPT. The results showed almost perfect agreement for both ChatGPT-3.5 (0.95), and ChatGPT-4 (0.97).

Our second query on ChatGPT started with 'the negative effects of the COVID-19 pandemic on education' and sample snapshots of ChatGPT's responses are illustrated in Figure 2.

RESEARCH THEME: The negative effects of the COVID-19 pandemic

Model: GPT-3.5

TY

What were the negative effects of the COVID-19 pandemic on education worldwide?



The COVID-19 pandemic has had significant negative effects on education worldwide. Some of these effects include:

1. **School closures:** To control the spread of the virus, many countries closed schools, colleges, and universities, disrupting the education of millions of students. This closure led to the loss of valuable classroom time and interrupted the learning process for many students.
2. **Unequal access to education:** The pandemic highlighted and exacerbated existing inequalities in education, with students from disadvantaged backgrounds and those in rural areas often unable to access remote learning opportunities due to a lack of resources, including technology and internet connectivity.
3. **Increased dropouts:** The prolonged school closures and economic downturn caused by the pandemic have resulted in an increase in dropout rates, with many students forced to leave school to work or care for family members.
4. **Mental health issues:** The pandemic has had a significant impact on students' mental health.

Regenerate response

Model: GPT-4

TU

What were the negative effects of the COVID-19 pandemic on education worldwide?



The COVID-19 pandemic had several negative effects on education worldwide, including:

1. **School closures:** At the height of the pandemic, schools and educational institutions around the world were closed, disrupting the education of millions of students.
2. **Remote learning challenges:** The shift to remote learning presented various challenges, such as inadequate access to technology and internet connectivity, as well as difficulties in adapting to online learning environments for both students and teachers.
3. **Widening educational disparities:** The pandemic exacerbated existing educational disparities, with students from disadvantaged backgrounds facing greater challenges in accessing remote learning resources and support.
4. **Mental health and social-emotional challenges:** The isolation and stress caused by the pandemic and remote learning affected the mental health and social-emotional wellbeing of students, teachers, and parents.
5. **Loss of learning:** Many students experienced learning loss due to the disruption in their education, with some struggling to catch up even after schools reopened.

Figure 2. Sample snapshots from the responses of ChatGPT-3.5 & ChatGPT-4 for the negative effects of the COVID-19 pandemic on education (generated on April, 16, 2023)

Both versions of ChatGPT stated that the COVID-19 outbreak had profound negative effects, which they presented as bullet list. Similarly, both ChatGPT-3.5 and ChatGPT-4 revealed that the COVID-19 pandemic caused mass school closures, dropouts, opportunity gaps in education, and harm on student mental well-being.

In addition, ChatGPT-3.5 stated that there were delays in the academic progress of students while ChatGPT-4 emphasized the stress and burnout experienced by educators during the pandemic along with learning loss, difficulties in distance learning, measurement and evaluation problems, social and emotional difficulties.

To evaluate the information provided for this category of query, we calculated the average values of ratings given by each researcher in terms of accuracy, clarity, conciseness, and breadth of information. The average values for the responses by ChatGPT-3.5 were 3, 2.67, 2.16, and 2 respectively. As for the responses by ChatGPT-4, the average values were 3, 2.83, 2.67, and 2.83 respectively. These values indicate that the responses generated by the both versions of ChatGPT regarding the negative effects of COVID-19 pandemic on education were quite satisfactory while ChatGPT 4 was capable of generating more satisfactory responses particularly with regard to conciseness and breadth of information.

The Cohen's kappa values were calculated to evaluate the inter-rater agreement on the quality of responses generated by both versions of ChatGPT. The results showed almost perfect agreement for both ChatGPT-3.5 (0.93), and ChatGPT-4 (0.91).

Our third query on ChatGPT started with 'the positive effects of the COVID-19 pandemic on education' and sample snapshots of ChatGPT's responses are illustrated in Figure 3.

RESEARCH THEME: The positive effects of the COVID-19 pandemic

Model: GPT-3.5

TY

What were the positive effects of the COVID-19 pandemic on education worldwide?



While the COVID-19 pandemic has had significant negative effects on education worldwide, it has also led to some positive developments, including:

1. **Increased use of technology:** The pandemic has accelerated the adoption of digital technologies in education, with many schools and universities transitioning to online and remote learning. This has increased access to education for some students and allowed for greater flexibility in teaching and learning.
2. **Innovative teaching methods:** The pandemic has also spurred the development of innovative teaching methods and pedagogies, with many educators experimenting with new approaches to engage students in online and hybrid learning environments.
3. **Collaborative learning:** Remote learning has encouraged collaboration and group work among students, as they rely on online tools to communicate and complete assignments. This has allowed students to develop important skills such as teamwork and digital collaboration.
4. **Increased access to resources:** increased access to educational

Model: GPT-4



What were the positive effects of the COVID-19 pandemic on education worldwide?



Despite the numerous challenges, the COVID-19 pandemic also led to some positive effects on education worldwide:

1. Acceleration of digital transformation: The pandemic forced educational institutions to quickly adopt digital tools and technologies, accelerating the shift towards blended and online learning.
2. Increased flexibility in learning: Remote and online learning platforms enabled students to access learning materials and resources at their own pace, providing greater flexibility and personalization.
3. Innovation in teaching and learning: Teachers and educational institutions experimented with new approaches, tools, and techniques to engage students and support learning during the pandemic.
4. Enhanced digital skills: Both students and teachers had to rapidly develop their digital skills to navigate remote learning environments, which could benefit them in the long run.
5. Greater emphasis on mental health and well-being: The pandemic brought mental health and well-being to the forefront, prompting educational institutions to prioritize the social-emotional needs of students and staff.

Figure 3. Sample snapshots from the responses of ChatGPT-3.5 & ChatGPT-4 for the positive effects of the COVID-19 pandemic on education (generated on April, 16, 2023)

ChatGPT-3.5 and ChatGPT-4 also underlined the positive effects of the COVID-19 epidemic despite a wide variety of negative effects. One of the positive effects they mentioned was the fact that COVID-19 process encouraged teachers and students to learn collaboratively and experiment with innovative learning approaches. In addition, both versions of ChatGPT emphasized the importance of health and well-being in education, as well as the increased use of technology in education and the improvement of both teachers' and students' digital skills during the pandemic.

In addition to this information, ChatGPT-4 emphasized that digital transformation accelerated during the COVID-19 pandemic, alternative evaluation methods such as project-based and performance-based evaluation were adopted, and the pandemic developed the capacity of students and teachers to be resistant to difficulties. It also underlined the increased collaboration among the educators, institutions and policy makers on a global scale during the COVID-19 process. ChatGPT-4 stated more comprehensively that the pandemic brought with it some positive outcomes that could be of use in the long run despite its initial harm on education.

The average values of ratings to assess the information provided for this category of query were as follows: 2.83 for accuracy, 2.67 for clarity, 2.16 for conciseness, and 2.16 for breadth of information provided by ChatGPT-3.5; 2.83 for accuracy, 2.83 for clarity, 2.83 for conciseness, and 2.67 for breadth of information provided by ChatGPT-4. As for the Cohen's kappa values, it was calculated as 0.96 for the inter-rater agreement on the quality of responses generated by ChatGPT-3.5 while the kappa value calculated for ChatGPT-4 responses was 0.92. Both values indicated almost perfect inter-rater agreement on the quality of responses generated for this category of query.

Our last query on ChatGPT questioned 'recommendations for enhancing the effectiveness of teaching and learning during the COVID-19 pandemic' and sample snapshots of ChatGPT's responses are illustrated in Figure 4.

RESEARCH THEME: Enhancing the effectiveness of teaching and learning

Model: GPT-3.5

TY

What would be your suggestions for enhancing the effectiveness of teaching and learning during the COVID-19 pandemic?



Here are some suggestions for enhancing the effectiveness of teaching and learning during the COVID-19 pandemic:

1. Focus on student engagement: In remote and hybrid learning environments, it is essential to prioritize student engagement. Educators can achieve this by using a variety of teaching strategies, such as interactive online platforms, breakout rooms, and gamification techniques.
2. Provide clear communication: Clear communication between educators, students, and parents is essential during the pandemic. Educators should provide regular updates on course content, assignments, and assessments, as well as provide clear guidelines for online learning expectations.
3. Foster a sense of community: Students may feel isolated during remote learning, so it is important to create opportunities for social interaction and community-building. This could include virtual study groups, discussion forums, and interactive online

Model: GPT-4

TU

What would be your suggestions for enhancing the effectiveness of teaching and learning during the COVID-19 pandemic?



Here are some suggestions for enhancing the effectiveness of teaching and learning during the COVID-19 pandemic:

1. Utilize technology effectively: Make use of digital tools and platforms for remote learning, such as video conferencing software, learning management systems, and educational apps, ensuring they align with learning objectives.
2. Maintain clear communication: Keep open lines of communication among students, parents, and teachers to provide updates, share resources, and address concerns.
3. Adapt teaching and learning methods: Adjust instructional strategies and learning approaches to suit remote environments, incorporating a mix of synchronous (live) and asynchronous (self-paced) activities that cater to diverse learning needs.
4. Foster engagement and interaction: Encourage students to actively participate in discussions, ask questions, and collaborate with peers to maintain engagement and a sense of community during remote learning.
5. Offer personalized support: Recognize that students may have different learning needs and provide individualized support, such as additional resources, tutoring, or modifications to assignments.

Figure 4. Sample snapshots from responses of ChatGPT-3.5 & ChatGPT-4 for recommendations for enhancing the effectiveness of teaching and learning (generated on April, 16, 2023)

Both versions of ChatGPT generated similar responses regarding ways to enhance the effectiveness of teaching and learning during the COVID-19 pandemic. For example, providing opportunities for building better communication between teachers, students and parents, promoting participation in online classes, developing ways to support effective interaction and socialization were particularly emphasized. In addition, providing regular, constructive, and timely feedback and increasing students' access to technology and open resources during the COVID-19 period was underlined as significant ways of promoting instructional effectiveness.

In addition to these common recommendations, ChatGPT-4 focused on making effective use of digital tools and software and suggested that different approaches of teaching and learning should be adopted to be used during distance education. Furthermore, ChatGPT-4 emphasized the need for supporting students' with different learning needs, and creating personalized learning environments as well as developing students' problem-solving skills, encouraging self-learning, enabling the continuous evaluation of learning effectiveness, encouraging cooperative learning, and caring for mental well-being.

The average values of ratings to assess the information provided for this category of query were as follows: 2.67 for accuracy, 2.50 for clarity, 2.16 for conciseness, and 2 for breadth of information provided by ChatGPT-3.5; 2.83 for accuracy, 2.67 for clarity, 2.67 for conciseness, and 2.83 for breadth of information provided by ChatGPT-4. As for the Cohen's kappa values, it was calculated as 0.93 for the inter-rater agreement on the quality of responses generated by ChatGPT-3.5 while the kappa value calculated for ChatGPT-4 responses was 0.90. Both values indicated almost perfect inter-rater agreement on the quality of responses generated for this category of query.

4. DISCUSSION

The current study investigated the effects of the COVID-19 pandemic on education worldwide using the two versions (3.5 and 4) of ChatGPT, an AI-based LLM. The study also evaluated the usability of ChatGPT as an alternative source of information that can provide accurate, clear, and concise information for educational research.

For the first query on the definition of COVID-19 pandemic, both versions of ChatGPT stated that a coronavirus named SARS-CoV-2 (severe acute respiratory syndrome-Coronavirus 2) caused this disease, which is similar to the definition made by Lu et al. (2019). However, while Lu et al. (2019) expressed this disease as an epidemic as indicated by World Health Organization (2020), ChatGPT-4 defined it as a global crisis as defined by some scholars in the literature (e.g. Jones & Comfort (2020). ChatGPT-3.5, on the other hand, stated that the disease was spread by respiratory droplets formed during coughing or sneezing of infected people, which was also underlined by scholars (e.g. Cascella et al., 2022). The responses generated by the both versions of ChatGPT included most frequently observed symptoms of the disease such as fever, cough and shortness of breath (Erbay, 2020; Verdecchia et al., 2020).

While some people infected by coronavirus did not show any symptoms or showed only mild symptoms (Liu et al., 2020), some people, particularly elderly or chronic patients, experienced severe health conditions such as multi-organ failure (Zhao et al., 2022). ChatGPT-4 underlined these severe health conditions while ChatGPT-3.5 did not. Measures taken globally to control the spread and negative consequences of COVID-19 such as wearing masks in public places, maintaining distance, and travel restrictions were all mentioned by the both versions of ChatGPT. These measures were also mentioned frequently in the literature

(Gandamayu et al., 2022). In addition, the emphasis of ChatGPT-4 that COVID-19 caused permanent changes in people's daily lives complied with the results of scientific studies (Haleem et al., 2020; Choi et al., 2021; Waluyo, 2022). In addition, both versions of ChatGPT addressed the significance of the development and distribution of vaccines during the pandemic, which was also underlined in the relevant literature (Rahman et al., 2022; Francis et al., 2022).

With regard to the effects of the COVID-19 pandemic on education, both versions of ChatGPT generated similar responses, indicating that the pandemic had an overall negative impact on education. The negative effects listed by both versions of ChatGPT were as follows: school closures, inequalities in access to education, increased school dropout rates, the deterioration of mental well-being, decrease in academic progress, and decrease in educational funds. These negative effects were all underlined in previous research as well (Brom et al., 2020; Russel et al., 2020; Chierichetti & Backer 2021; Oliveira et al., 2021, Li & Che, 2022). In addition to these effects commonly mentioned by the both versions, ChatGPT-4 also emphasized learning losses, difficulties in adapting to distance learning, increased teacher stress and burnout as negative effects of COVID-19 pandemic on education, which were also identified in previous research (Schuurman et al., 2023; Restu et al., 2023; Bawaneh & Malkawi, 2023; Tulaskar & Turunen, 2022; Kotowski et al., 2022).

In contrast to these negative effects, we also conducted a query on the positive effects of COVID-19 on education, which required more critical evaluation of existing knowledge. Both versions of ChatGPT stated that COVID-19 pandemic might have had some positive outcomes in the long run despite the frequently-mentioned negative effects. Among the positive effects identified by ChatGPT were encouraging collaborative learning and adopting innovative learning approaches, methods and techniques. Likewise, Pokhrel and Chhetri (2021) stated that the COVID-19 epidemic promoted digital learning, improved communication between teachers and parents, and improved online teaching methods. Responses generated about the ways of increasing the effectiveness of teaching and learning during the COVID-19 pandemic were also similar, and both versions of ChatGPT recommended that effective means of communication between students, teachers and parents should be facilitated, and the social interaction among students should be maintained through encouraging them to participate online classes and activities.

In addition to these recommendations, ChatGPT-4 also underlined the significance of addressing the different learning needs and creating personalized learning environments where students can make effective use of digital tools and software. Almoza et al. (2020) stated that, during the COVID-19 pandemic, teachers should have applied active, collaborative teaching methods and helped students create their own online learning styles. ChatGPT-4 also emphasized developing students' problem-solving skills, encouraging self-learning, performing continuous evaluation of learning effectiveness, encouraging cooperative learning, and supporting students' mental well-being as significant means of providing better education during crises such as COVID-19 pandemic. Similarly, Iyer et al. (2020) suggested that critical thinking skills of students should be facilitated by increasing peer interaction via synchronous teaching, collaborative learning and problem-based learning (PBL) approaches during circumstances like COVID-19 pandemic. Sahu (2020) added that appropriate counseling services should be provided to support students' mental health and well-being.

5. CONCLUSION

The current study, which investigated the effects of the COVID-19 pandemic on education using information provided by ChatGPT, showed that the responses generated by the two versions of this AI-supported chatbot largely complied with the findings of studies on educational outcomes of COVID-19 pandemic. As a result, it can be stated that ChatGPT can be used as an alternative data source in scientific research, particularly to gather synthesized, prior knowledge on a topic under investigation, but with meticulous and careful consideration of the provided information considering that these AI-based chatbots have not yet completed their development and training. However, it is also enthralling to see the advancement of such technologies with promising results that could take the process of scientific quest one step further, and accelerate the scope and speed of knowledge production for the benefit of humanity.

The current study made an original contribution to the literature through conducting a comparative analysis of the information yielded by ChatGPT-3.5 and ChatGPT-4, which helped to show how this AI-based technology improved in a very short-span of time given that ChatGPT-4 was far beyond its previous version in generating more comprehensive, synthesized, and categorical information. However, as any study, this study also bears some limitations. For one thing, the queries in the study were performed in only English language. Although ChatGPT is capable of understanding and responding in numerous languages other than English, its performance changes based on the language, and the present results only represent its performance in English. Therefore, future studies conducted in other languages could contribute to the literature significantly. For the other, the information gathered via ChatGPT is limited to our queries and the topic of investigation. In addition, the analysis of responses was based on the evaluations of a group of researchers from diverse sub-fields of education. Therefore, the results presented could inevitably reflect their subjective understanding and thinking. To overcome this limitation and avoid bias, we used several methods of analysis such as Cohen's kappa and three-dimensional evaluation criteria, which we believed supported the rigor of our work. Conducting future studies with a broader participation of researchers from diverse disciplines and backgrounds could help yield more comprehensive results, and would promote developing ways to integrate these newer technologies ethically and efficiently into the process of scientific knowledge creation.

DECLARATIONS

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