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ChatGPT Effects on 21st Century Skills of University Students: A Systematic Seview

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Abstract

This study was carried out to investigate effects of ChatGPT on 21st century skills of university students. Since there are several 21st century skills, the study focused on only five (i.e. critical thinking, communication, collaboration, creativity, and problem-solving skills). The study employed systematic review of literature in which PRISMA framework was employed to facilitate selection of studies included in the review. Findings revealed that ChatGPT poses effects to students on each of the 21st century skills. However, the type and magnitude of effects depends on the type of skill. ChatGPT was found to bring more positive impacts to university students' communication skills while more negative impacts on collaboration skills. While that was the case, the study found that ChatGPT can bring either positive or negative impacts on critical thinking, creativity and problem-solving skills. The effects depend mainly on the magnitude of students' dependency on it. Those that depend more on it are likely to be more negatively affected. For instance, the more the students depend on ChatGPT, the less the ability for them to think critically and solve problems. The study recommends, therefore, that universities should embrace ChatGPT instead of avoiding it. However, they should strive to implement mechanisms such as establishing relevant guidelines as well as instituting AI literacy programs that help to reduce students' over-reliance on it, among others.

Keywords: *ChatGPT, University Students, 21st century skills, Higher Education Institutions*

Introduction

For years, Higher Education Institutions (HEIs) focused on traditional academic knowledge which equipped students with attitude, skills and knowledge within their domains of study (Cervantes, 2017). However, the labour market requirements have significantly changed. The 21st century brought an era of novel aspects, unlimited possibilities, and state-of-the-art innovations in the labour market. Employers are increasingly value interdisciplinary competencies and skills that are not primarily based on students' content knowledge (Dede, 2010). A study by Kienzler et al. (2023) indicates that many workers are now engaged in jobs requiring critical thinking, problem-solving and complex communication skills. Such kinds of skills constitute some of the 21st century skills.

The concept of 21st century skills, according to Dilekçi and Karatay (2023), appeared for the first time in 2006 in the Organisation for Economic Co-operation and

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Development (OECD) project. The project, among other aims, defined skills that are expected to be possessed by people in the 21st century. It was indicated, in the project, that the 21st century demands special competences necessary for mastering every aspect of life in facing the challenges of uncertain prospects in the future. Along with OECD, many other institutions such as the World Economic Forum and the British Council have been involved in categorizing, teaching and testing 21st century skills in schools and universities (Kienzler et al., 2023). The United Nations Development Programme (UNDP) describes the following as some of 21st century skills: critical thinking, communication, collaboration, creativity, and problem-solving. Others are digital literacy, global citizenship and conflict management, flexibility and adaptability, and empathy and self-direction (UNDP, n.d.).

Studies show an increased use of ChatGPT, a general-purpose conversation chatbot-based Natural Language Processing (NLP) system that produces well-structured, logical, and informative responses that exhibit the response-generating ability of human beings (Duong et al., 2023), among university students (Urban et al., 2024; Hasanein & Sobaih, 2023; Romero-Rodríguez et al., 2023). Students use ChatGPT for several reasons. Most of such reasons are oriented to their educational undertakings. For instance, according to Matto (2024) and Firat (2023), most university students use ChatGPT for accessing resources for their personalized learning, interactive learning, and getting instant assistance in undertaking assignments. Consequently, previous works attempted to establish merits and detriments

of the ChatGPT in students' learning process. However, most of them focus on students' classical knowledge domains (Youssef et al., 2024; Matto, 2022; Acosta-Enriquez et al., 2024; Duong et al., 2023; Hasanein & Sobaih, 2023). But, as said by Dede (2010), the present world demands more than traditional knowledge acquired through conventional courses. In fact, the world demands people who are well equipped with 21st century skills.

Unfortunately, the majority of previous scholars did not investigate the effects of ChatGPT on 21st century skills as a specific area of focus. Most prior studies that considered 21st century skills focused on only one skill at a time (see for example Urban et al., 2024; Harahap, 2024; Kim et al., 2024; Dempere et al., 2023; Toma & Yánez-Pérez, 2024; Swaraj Chavan, 2024; Romero-Rodríguez et al., 2023). This limits comparative analysis of effects of the tool on a wide range of skills, and thus, limited knowledge regarding which skill aligns better with ChatGPT as compared to others. It was against this backdrop the present study was carried out to investigate effects of ChatGPT on 21st century skills of university students. Since there are many 21st century skills, the study focused only on the following five: critical thinking, communication, collaboration, creativity, and problem-solving skills. The reasons for their choice were twofold. First, these are skills that ChatGPT can play a role in either supporting or destroying their acquisition, and second, they are among top 21st century skills listed by the majority of scholars (Dilekçi & Karatay, 2023 & Cleaves, 2015). Consequently, the study sought to answer the following key questions: What effects doe's regular interactions with ChatGPT have on

the students' critical thinking skills? How dependence on ChatGPT does affects communication skills among students? What impact does over-reliance on ChatGPT have on students' collaboration skills? In what ways does ChatGPT serve as a catalyst or barrier to creativity among university students? And, how does ChatGPT affect problem-solving skills of university students? Answering these questions underscores the potential impact of the study on educational practices.

Theoretical Framework

This study was informed by two theories: constructivism theory and the Theory of Reasoned Action (TRA). The constructivist theory claims that learners construct their own knowledge through engaging and not by being passive recipient of information (Lunenburg, 2011). Researchers such as Hasanein and Sobaih (2023) and Makewa (2019) suggest that ChatGPT provide opportunities to support the constructivist learning experience as it enables students to construct their own knowledge through asking it questions and getting instant response. However, on the other side, some scholars (see for example, Rasul et al. (2023)) posit that habitual use of ChatGPT hampers students'I personal reflections on subject matters which are necessary in accomplishing the learning outcomes. If this happens, it will eventually have effects on the 21st century skills.

On its side, TRA explains the relationship between attitudes and behaviours within human action. It stipulates that a person's behaviour is determined by their behavioural intention and that such an intention is, in turn, a function of their attitude toward the behaviour and subjective norms (Fishbein and Ajzen, 1975). In this regard, TRA is made of four blocks: belief, attitude, subjective norms, behavioural intention, and behaviour, as shown in Figure 1. Attitude is the overall evaluation of the behaviour by the individual. For instance, if someone thinks that a certain action will lead to desirable outcomes, they will have a positive attitude toward it, and vice versa. Subjective norms consist of a person's beliefs about whether the important people in his/her life think he/she should engage in the behaviour. In other words, subjective norms suggest that attitudes are affected by beliefs. For instance, a young person may think they will seem cooler if they smoke. Behavioural intention is the readiness to perform a behaviour, in which the stronger the intention to perform the behaviour, the more likely the behaviour will be performed. In this case, attitudes and subjective norms affects behavioural intentions.

Figure 1.
The Theory of Reasoned Action (Source: Fishbein & Ajzen, 1975)
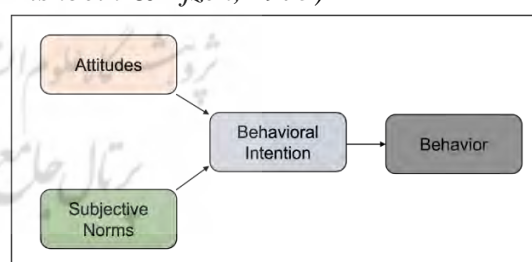

In a general view, TRA is mainly used to predict how individuals will behave based on their pre-existing attitudes and behavioural intentions. The theory can be applied in the present study's context in which competences in the 21st century skills (behaviours) are affected by the use of ChatGPT (behavioural intentions). In the same study's context attitudes are the

students' evaluation regarding the use of ChatGPT in their studies. In this case, students can be thought of believing that ChatGPT brings desirable outcomes in their learning and thus have a positive attitude towards it. And finally, subjective norms are student peers as well as instructors who believe that students should incorporate ChatGPT in their learning. Figure 2 shows a contextualised theory of reasoned action as per the focus of this study.

Figure 2.

Contextualized Theory of Reasoned Action
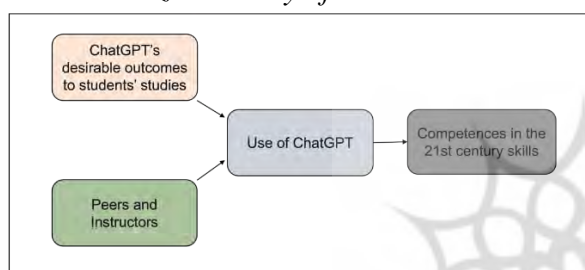
Methodology

The study was based on systematic literature review in which empirical evidence from existing studies regarding the effects of ChatGPT on the 21st century skills of university students was investigated. The literature that was used included journal articles, conference proceedings, reports, books, case studies, and informational web contents. A comprehensive search was conducted to obtain studies for review. The searching was done in existing databases including DOAJ, Google Scholar, JSTOR, EBSCO and Web of Science. Searching was

also done to obtain publications from other sources including related informational websites. The search was performed using phrases related to the effects of ChatGPT on the 21st century skills of university students. The phrases included "ChatGPT" AND "university students" OR "Critical thinking" OR "communication skills" OR "collaboration skill" OR "creativity" OR "problem-Solving skills". The searching was limited to only English articles published within the past five years.

A total of 191 articles were identified from this search; 163 from databases and 38 from other sources. After removing duplicated articles, a total of 106 remained. A total of 26 articles were found to be irrelevant, thus excluded. After thorough screening of the remaining 80 articles, 35 were excluded because the study couldn't retrieve them in full. A total of 45 full-text articles were, thus, found to be eligible for analysis. However, 9 of them were found to have technical issues, therefore dropped. Thus, the final number of studies that were included in the review was 36 as summarized in a PRISMA framework in Figure 3. The content analysis approach was employed in the elected literature in which themes were extracted as per the five focused 21st century skills and main points from each theme were summarised. The results of the analysis were then presented and discussed in the results and discussions section.

Figure 3.

PRISMA framework showing inclusions and exclusions of reviewed articles
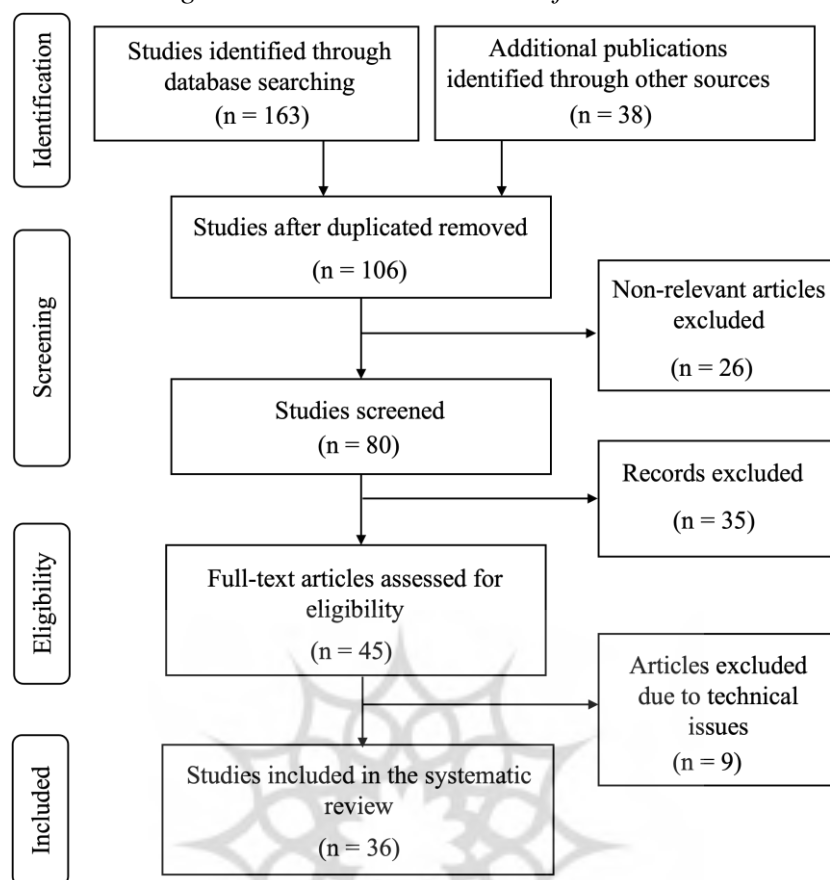
Results and Discussions

Critical thinking

With regard to the ChatGPT effects on university students' critical thinking skills, the study found mixed opinions among previous researchers. Some feel that the tool enhances critical thinking while others are of the opinion that it diminishes it. Emran et al. (2024), for instance, conducted a study that investigated the use of ChatGPT responses to 61 university students as a method to improve their critical thinking potentials among other skills. The study found that the program for using ChatGPT helped students improve their critical thinking skills. Similarly, a study by Guo & Lee (2023) which was also based on primary data from students' engagement with ChatGPT found that ChatGPT brings a significant improvement in students' critical thinking skills, especially when requiring them to dig into complex questions, analyse facts and draw logical conclusions. The authors, thus, recommended employment of ChatGPT as a tool for enhancing students' critical thinking. The same views were observed in Muniandy & Selvanathan (2024).

On the contrary, a study by Lo et al. (2024) which was based on a review of existing literature, raised concern that the growing use of ChatGPT declines students' critical thinking.This was said so because, as per the authors, many students do not fact-check and validate information produced by ChatGPT. Similarly, studies by Nicolas (2023) & Ferreira (2024), which is also based on a systematic literature review, supported by case studies and some semi-structured

interviews with teachers, found a major disadvantage of using ChatGPT for students is the potential for over-reliance on it, which can hinder their critical thinking and independent learning. Further, Krupp et al. (2024) highlighted missing reflection and limited critical thinking as two of the main issues when students use ChatGPT in education.

Although the contradicting perceptions could have been partly contributed by the methodological stances of the studies, but they generally imply that ChatGPT has the potential to either create or destroy critical thinking skills of university students. This is supported by Akastangga et al. (2023) and Hasanein & Sobaih (2023) who revealed a moderate effect of ChatGPT on students' critical thinking skills in which excessive dependence on ChatGPT is likely to reduce the level of critical thinking skills. Therefore, it is reasonable to suggest that it is important for university students to reduce over-reliance on ChatGPT and cultivate a culture of analytical reasoning. This can be achieved by deeply analysing information and embedding their own perspectives in the answers provided by ChatGPT.

Communication

Another fundamental competence that this study looked at was communication skills. The study findings revealed that, regarding communication skills, scholars consider ChatGPT is creating more positive than negative impacts to university students. For instance, Zhou et al. (2023) found that regular interactions with ChatGPT increase learners' competence to communicate. Likewise, as stated by Montenegro-Rueda et al. (2023), ChatGPT enhances students' written communications because by interacting with it, students receive grammatical corrections which improves their writing skills. ChatGPT was also found to improve students' mathematical communication skills (Septiani et al., 2024). Further, with its ability to provide real-time natural language interactions, ChatGPT not only assists in training students' communication skills but also prepares them to handle various international business situations (Mustafa and Ausat, 2024; Muniandy & Selvanathan, 2024). This finding is supported by Al Shloul et al. (2024) who found that students can improve their communication skills by using ChatGPT through having real chats with other students. According to the authors, this improves not only how they communicate but also skills to work with one another. The issue of working together is indicated also in Montenegro-Rueda et al. (2023) who asserted that ChatGPT excels in its ability to facilitate group discussions and promote collaborative student participation in projects and assignments.

While studies indicate positive impacts of ChatGPT in terms of improving students' communications skills, it is essential to understand that the tool should not be considered as a complete solution. The 21st century's communication skills go beyond writing, it is important for universities to consider other avenues in developing effective listening and speaking skills. As also said by Sinha & Sinha (2007) students need to be imparted with emotional awareness and management skills as part of improving their communication skills. In addition, the five w's and h of communication (i.e. who, what, when, where, why and how to communicate) cannot be developed by ChatGPT alone. Thus, while ChatGPT presents an opportunity to improve

communication skills to university students, there must be further complementary initiatives

Collaboration

Collaboration skill is essential to university students as it prepares them to become individuals who are capable of not only working with others but also able to learn from, share with, and express themselves in an effective way, which are essential ingredients of the 21st century skills (Cleaves, 2015). Although a majority of studies conducted to establish the contribution of ChatGPT in the building of collaboration skills to students showed that the tool is generally bringing more isolations than working together among students, some studies suggest the oppositr. Osman et al. (2024) & Aithal & Aithal (2023) for example, found that ChatGPT facilitates collaboration through virtual peer interactions by allowing students to engage in conversational exchanges that mimic real-life discussions. In so doing, as per the authors, the tool encourages students to collaborate, debate, and share assignments and ideas.

On the contrary, Rasul et al. (2023) found that students who interact primarily with ChatGPT, do not engage in collaborative learning and discussion. Similarly, according to Hasanein & Sobaih (2023), if ChatGPT becomes a primary source of learning and assistance, it brings a negative influence on students' social interaction in education. This is confirmed by a statistical analysis by Kim et al. (2024) which found that ChatGPT diminishes the level of active learning interactions between students, a crucial element for successful collaborative learning. This happens because depending on ChatGPT for learning guidance reduces opportunities for face-to-face interactions between students themselves and between students and their instructors. In turn, peer collaboration is discouraged resulting in less interpersonal communication and thus diminishing skills to collaborate. The less effectiveness in collaboration while at the university implies the same to students even after graduating (Delbanco, 2023) Most of the studies that highlighted the negative impacts of ChatGPT on collaboration skills underscored, however, that it happens only if there is overreliance on the tool.

Creativity

The findings of this study revealed a mixed feeling amongst scholars regarding the effects of ChatGPT in stirring-up creativity. Some feel that it has positive effects while others are on the opposite view. Regarding the positive impacts, a study by Toma & Yánez-Pérez (2024) which aimed at investigating the impact of using ChatGPT on undergraduates' creativity found no evidence that ChatGPT negatively affects creativity to students. In particular, the results showed that 53.57% of undergraduates who participated in it experienced improvement in their creativity upon using ChatGPT while 25% experienced decreased creativity. Likewise, a study by Swaraj and Chavan (2024) which involved 202 respondents found similar results. In that study, a total of 101 (equivalent to about 47.6%) respondents reported a significant positive impact on their creativity skills from using ChatGPT, while 16 (approximately 7.5%) indicated that ChatGPT had no effect on their creativity. Similar positive impact of ChatGPT on students' creativity was observed in Urban et al. (2024).

On the other hand, Dwivedi et al. (2023) found that ChatGPT kills creativity since its solutions lack originality. This was supported by Matto (2024) & Hasanein & Sobaih (2023) who argued that the use of ChatGPT can diminish students' creativity. Further, in a study by Qawqzeh (2024) in which respondents who were on the view that ChatGPT does not enhance creativity exceeded those who were on the opposite view. Specifically, out of 515 respondents who participated in that study 181 (35.1%) believed that ChatGPT does not enhance creativity while 141 (27.4%) believed that it helps in generating creativity among students.

These contradicting findings entail that the effect of ChatGPT on creativity is not entirely positive or negative; it depends on the way in which students use it. Nevertheless, since it has potentials for bringing-in positive impacts, it should not be avoided in universities as a tool for enhancing creativity but, instead, students should be oriented to use it correctly for the desirable positive impacts on their creativity.

Problem-Solving

As it is in some other aspects of 21st century skills, there are diverse perspectives of scholars with regard to the impact of ChatGPT on students' problem-solving skills. A study by Urban et al. (2024) which investigated creative problem-solving performance in university students found that ChatGPT can provide support to students in the iterative development of their ideas, in which exploring those ideas in a greater detail, enables them to investigate the problem space in more depth, and thus develop more skills to solve the problem. Similarly, Bai et al. (2023) found that

by automating routine tasks, ChatGPT can allow users to conserve mental energy, thereby facilitating higher-order cognitive functions such as problem-solving skills. Further, a study by Sart (2023) found that 86% of involved students indicated that ChatGPT helped them in comprehending the most complex concepts and in problem-solving. Other studies like Kılınç (2023) conclude also that ChatGPT develops problem-solving skills for university students.

On the other hand, however, there are scholars who believe that ChatGPT does not create problem-solving skills. Particularly, in their study, Krupp et al. (2024) analysed the impact of ChatGPT on problem-solving strategies of students and found that students who use ChatGPT perform significantly worse in terms of problem-solving compared to those not using it. This is in line with a study by Hasanein and Sobaih (2023) which claimed that the use of ChatGPT can decrease students' problem-solving abilities. Similarly, Khangkhan et al. (2024) revealed that while ChatGPT proves to be a valuable tool in enhancing problem-solving abilities among training staff, it provides an opposite reality when it is used by university students. Ferreira (2024) indicated that the reason might be students' overdependence on it which might limit their ability to solve problems on their own.

As it has been presented, one reason for the contradicting effects of ChatGPT with regard to problem-solving is determined by students' dependency on the tool. The more the dependency the less the ability for them to think critically and solve problems. This, again, calls for university educational stakeholders to find ways to help students to

balance the use of ChatGPT for their improved problem-solving skills.

Practical Implications

The study provides a comprehensive synthesis of existing studies with a focus of highlighting the effects of ChatGPT on 21st century skills of university students. While previous studies investigated a single skill at a time, this study focused on five skills (i.e. critical thinking, communication, collaboration, creativity, and problem-solving skills). This allowed comparative analysis of them in a single study. As a result, the study provides practical and impactful insights to educational stakeholders with regard to how and to what extent ChatGPT affects students' respective skills. For example, it has shown that, based on the magnitude of dependency, ChatGPT can bring positive or negative impacts on critical thinking, creativity and problem-solving skills. This means ChatGPT affects university students differently. While some benefit by improving their critical thinking, creativity, and problem-solving skills, others experience skill deterioration due to over-reliance on the tool.

On the other hand, ChatGPT brings more positive impacts on some aspects of communication skills and more negative impacts on collaboration skills in which existing studies show that the tool is generally bringing more isolations than working together among students. While previous studies indicate positive impacts of ChatGPT in terms of improving students' communication skills, the present study highlighted that ChatGPT should not be considered as a complete solution to the 21st century communication skills as such skills go beyond writing. Universities have been urged to consider other ways of improving students' effective listening and speaking skills as well as emotional intelligence.

Balancing the use of ChatGPT with creative autonomy requires a structured and deliberate frameworks rather than relying only on theoretical cautions. This demands, for instance, redesigning of assessments to foster academic honesty and integrity. Instructors should cultivate an environment where AI complements instead of replacing humans' positions. In that sense, students must be taught on how to use ChatGPT wisely rather than stopping them from using its.

Theoretical Implications

The study's findings support the constructivism theory. The study has shown that when students are engaged in learning activities (such as virtual interactions) through ChatGPT they build and improve their 21st-century skills. With regard to TRA, the study in some way concurs with the contextualized theory of reasoned action. Although it is true that the use of ChatGPT (i.e. behavioral intention) contributes to the building of 21st century skills (behaviors) as elaborated in the study, unlike TRA which claims that the stronger the behavioral intention, the more likely the behaviour happen, it is not necessarily true that the stronger the use of ChatGPT, the more the competence in the 21st century skills. Sometimes, this happens vice versa. That is, the more the use and dependency on ChatGPT the lesser the 21st century skills. This was specifically identified in collaboration skills, for example. It is not surprising therefore that studies like Duong et al. (2023) suggested moderated use of ChatGPT. Concerning ChatGPT's desirable

outcomes to student studies (i.e. attitudes) and pressure from peers and instructors (i.e. subjective norms), it was found that they influence the use of ChatGPT, which concurs with the theory of reasoned action.

Conclusion and Recommendations

The study has shed light on the effects of ChatGPT on 21st century skills of university students. By undertaking a thorough review on five skills (i.e., critical thinking, communication, collaboration, creativity, and problem-solving skills), the study unveiled considerable impact on pedagogical practices, engagement, and academic outcomes with regard to the use of ChatGPT amongst university students. The findings highlight that ChatGPT poses effects to students on each of the surveyed skills. However, the type and magnitude of effects depends on the type of skill. ChatGPT is found to bring more positive impacts to university students' communication skills. The tool enhances mainly written communications in which it was found that by interacting with it, students receive grammatical corrections which improves their writing skills. Other aspects of communication skills such as listening and speaking skills are not well addressed by ChatGPT. It was found further that ChatGPT affects collaboration skills in which the tool brings more isolations to students which reduces their ability to collaborate. While those were the case, this study found that ChatGPT can bring either positive or negative impacts on critical thinking, creativity and problem-solving skills. The effects depend mainly on the magnitude of students' dependency on it. Those that depend more on it are likely to be more negatively affected. For instance, it was found that the more the students depend on ChatGPT, the less the ability for them to think critically and solve problems.

Since ChatGPT has potential to bring-in positive impacts, the study calls for universities to embrace it instead of avoiding it. However, universities should endeavour to reduce students' over-reliance on it by implementing respective guidelines as well as AI literacy programs to ensure ChatGPT is used productively. In addition, universities should cultivate a culture of analytical reasoning by requiring students to deeply analyse information provided by ChatGPT and embed their own perspectives in the answers it provides. There is also a need to incorporate more hand-on activities and assignments that require not only deep thinking but also collaborative works by students. Further, while ChatGPT presents an opportunity to improve communication skills to university students, there must be further complementary initiatives to improve students' effective listening and speaking skills as well as emotional intelligence. The future research directions would be to undertake the study using primary data to see if same results will be obtained. It is important also to include other 21st century skills as some of them were left out in this study.

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