Exploring the potential impact of ChatGPT on student learning activities

Aibhe Byrne

aibhe.byrne.2022@mumail.ie

Department of Computer Science, Maynooth University

Maynooth, Co. Kildare, Ireland

Peter Mooney

peter.mooney@mu.ie

Department of Computer Science, Maynooth University

Maynooth, Co. Kildare, Ireland

ABSTRACT

Many recent studies have highlighted both the concerns and aspirations of teachers and academics around ChatGPT. However, we believe that the student voice is missing in these conversations and discussions. Integrating Artificial Intelligence (AI), such as ChatGPT, into education offers numerous opportunities to enhance learning experiences, personalize instruction, and transform the role of educators. Students, as key stakeholders, must also be involved in continuous dialogue and collaboration around these topics. Encouraging the adoption of AI-supported learning environments must be carried out whilst still promoting self-directed learning requiring student input and feedback. We report on results from an undergraduate research project recently undertaken which carried out (1) a short literature review of emerging papers and reports on ChatGPT in education and (2) conducted a survey of University students (undergraduate and postgraduate) on their attitudes and opinions around ChatGPT's impact on their learning journeys and education. Our research indicates broad student support for use of ChatGPT in their learning. However, notably, 67% of respondents prioritised 1-to-1 tutoring, independent learning, and improved feedback over ChatGPT supports. This indicates the need to use AI tools complementary to existing educational and learning supports.

KEYWORDS

Education, ChatGPT, Large Language Models, Generative AI, learning activities

1 INTRODUCTION AND MOTIVATION

ChatGPT combines the generative powers of GPTs (generative pre-transformer) and a chatbot style interface to deliver an engaging experience to users. ChatGPT is capable of many writing tasks such as creative writing, grammar and spell checking, and formatting help, as well as other tasks like computer coding [24], sports predictions, heathcare advice [21], tackle examinations [11], doing maths, providing informational accounts and much more. Released in November 2022, millions of users signed up in the first few days, ChatGPT became a global sensation. It integrates various abilities of natural language processing, including question answering, storytelling, logic reasoning, code debugging, machine translation, and so on. GPT-3.5 (or GPT-4) is the foundation model which ChatGPT was built upon. These are *pre-trained* and then *adapted* via fine-tuning learning strategies and are subsequently deployed on a wide range of knowledge domains. Education is one of those knowledge domains and this is the core focus of this paper.

The research question tackled by this work was to investigate the current state of AI or more generally ChatGPT, specifically with regards to education, from a student or learner's perspective.

To address this question a mixed research approach combining a literature review and survey was carried out. As outlined in Kasneci et al. [12] ChatGPT can assist third level students in research and writing tasks, as well as in the development of critical thinking and problem-solving skills. It can help them to better understand and analyze research material. In learning tasks, it can provide real-time feedback and personalized guidance to students, automatically generate questions and provide practice problems, explanations, and assessments that are tailored specifically to the student. The student perspective on how ChatGPT is used in teaching and learning is immensely important. Many authors, such as Pavlik [18] have emphasised this arguing that "it is important to note that the use of LLMs should be integrated into the curriculum in a way that complements and enhances the learning experience, rather than replacing it".

Our work was undertaken as part of a summer undergraduate research project with a duration of approximately 8 weeks. We carried out a short literature review of relevant papers around the topic of ChatGPT in education. More specifically, we tried to investigate research activities reporting findings with an emphasis on the impact of ChatGPT on student learning activities. A survey, investigating student attitudes and opinions around ChatGPT in their learning actvities, was also conducted during the course of this research. Broadly speaking student respondents in the survey supported the use of ChatGPT in their learning with over half of respondents believing that ChatGPT would "change how students learned". Notably, 67% of respondents prioritised 1-to-1 tutoring, independent learning, and improved feedback mechanisms within existing technologies over ChatGPT supports.

The remainder of this paper is structured as follows. In section 2 we provide some discussion on the literature reviewed as part of this research project. We outline, in section 3, the experimental methodology for our student survey. Section 4 provides some results and discussions from both our survey and our own interpretations of the response data. Finally, the paper closes in section 5 with some brief conclusions and a few indicators for directions for future work.

2 BACKGROUND AND LITERATURE

We devised a simple scheme to identify useful and impactful research works for this review. We conducted searches using Google Scholar[1] and ScienceDirect[2]. We used a small selection of keywords: ChatGPT, examinations, teaching and learning. Using these keywords we searched both Google Scholar and ScienceDirect obtaining around 90 papers, including some grey literature. We then

---

[1]https://scholar.google.com
[2]https://www.sciencedirect.com/

undertook a process of initial screening of title, abstract, and keywords and pruned this set of papers down to around 25 papers with a focus on publications appearing in peer-reviewed journal outlets. We also pruned based on the date of publication as we focused on peer-reviewed papers appearing after November 2022 (the public release date of ChatGPT) where ChatGPT was an explicit component. We retained some other literature dealing more broadly with the topic of AI in Education. The reduction of papers to 25 in total made the task of full-text screening more manageable. Whilst this is not a systematic literature review, the screening process allowed us to obtain a good overall view of the current literature [7].

2.1 ChatGPT and examinations

Many of the recent studies report focus on the performance of ChatGPT in various types of examinations and tests rather than trying to measure the performance of human students assisted by ChatGPT in similiar situations. Fijačko et al. [6] showed ChatGPT did not reach the passing threshold for any of the exams in the American Heart Association (AHA) examinations. Gilson et al. [9] showed ChatGPT achieved the equivalent of a passing score for a third-year medical student in the the United States Medical Licensing Examination exams. Newton [17], after a meta review, concluded that ChatGPT "fails to meet the passing grade on almost every MCQ exam that it is tested against, and performs significantly worse than the average human student" Strong et al. [23] considered ChatGPT's performance for free-response, case-based clinical reasoning assessments. Whilst ChatGPT did pass overall the author remarked that this was "an unremarkable result". Finally, Kortemeyer [13] showed that ChatGPT would have achieved a 1.5-grade in a standard introductory physics lecture course which is good enough for course credit but lower than the grade-point average required for graduating with an undergraduate degree. News about ChatGPT passing different types of exams have caused reflection and investigations into not only ChatGPT's and LLMs' abilities but what those examination performances told us about the current education system and our way of examining students [15, 25]. Having a non-human with no context in a situation given, as well as having a restricted database of information passing some of the most well-known difficult exams today "is quite shocking" [22]. Some authors suggest that rather than considering ChatGPT as "a tool for cheating" [13] it should make us investigate what are the inherently human skills and competencies that we need to convey to students? Rudolph et al. [19] believes that "major changes" to traditional higher education assessments such as essays and online exams are in order to address the existence of increasingly powerful AI, "unless universities want to be akin to driving schools that teach to ride horses". While reflecting and looking at our education system through the lens of AI has helped point out possible faults in education, some also believe that AI has the ability to help us address them [1].

2.2 Student acceptance of ChatGPT

Himang et al. [10] attempted to measure or understand student acceptance and use of ChatGPT in order to try gain a deeper understanding into the tool's effects on student learning and outcomes. In mid 2023, UNESCO published a guide to AI usage in Higher Education [20] where possible use cases for ChatGPT in education were outline. Many of the functions described, such as "Personal Tutor" or "Exploratorium" did align well with what respondents to our survey (see section 4) considered important supports in their own education. Several papers tackle the issue of ChatGPT's potential risks and issues upon use, such as misinformation, bias, and a possible future over-reliance by users. The methods of training and the attempts to identify so called "toxic" and biased content clearly indicated misinformation as a major problem at present [16]. Reinforcement learning through human feedback (RHLF) is used as ChatGPT's training style, where the AI is trained with its dataset and another model is trained directly by humans to query the generative AI bot. Humans mark responses as correct or not and re-weigh values given and used. UNESCO's "ChatGPT and Artificial Intelligence in higher education"quick guide [20], shows potential use for ChatGPT and AI as a student tool - it shows great capabilities if treated as a study buddy, a debate candidate, or even just a tutor. Our survey highlights students placing a great priority for certain learning supports, such as getting practice questions and receiving feedback on the answers, receiving multimodal resources in learning, and performing mock quizzes on course content.

2.3 Literature Review Summary

As our brief literature review shows there has already been considerable work done on evaluating ChatGPT within education, despite (at the time of writing) ChatGPT only being available publicly since November 2022. Much of the work reported looks on how ChatGPT would perform as a student or hypotheses around how students could use ChatGPT for positive or negative outcomes in their learning. It is necessary however that students are more deeply integrated into this scholarly conversation of the issues around ChatGPT. Questions that must be asked, from the student perspective, include how well students think ChatGPT will perform, how much students believe ChatGPT will impact their education, and what students think ChatGPT says about the future of AI in their lives. Borji [2] asked students about their knowledge of ChatGPT performance. This confirmed that there is a need for more general and accessible information being made available about this type of technology, especially in academic settings, so that students can be aware of the tool that they are interacting with in their studies, as well as to lessen fears surrounding students' performance credibility and future job prospects.

3 EXPERIMENTAL METHODOLOGY

It is important to note that this research took place during the summer of 2023. As a survey was a major component of this work we realised that there may be some difficulty in finding students available, during the summer vacation period, who were available to take part in the survey as participants. We developed a survey questionnaire containing 14 questions using Microsoft Forms. Depending on the options chosen it was not necessary to answer or respond to all questions. Questions required different types of responses including: open free text, selection from a Likert scale, ordering of options based on preferences or perceived priority. Ethical approval was granted by the host department. Following this approval the link to the survey was distributed to several different

student cohorts: Second year undergraduate students studying computer science or psychology (the first author is a member of this cohort), other summer research project students students and supporters, as well as some postgraduate e-mail lists. When we closed the survey, we had obtained a total of 52 usable responses with 43 from undergraduate students and 9 coming from postgraduate students. Responses were anonymous. No information other than the study status (undergraduate, postgraduate) was asked from the respondents. We acknowledge that this is a smaller set of responses than we had hoped to attract. There were no incentives available for participation in the survey. The time of year seen many undergraduate students being away and not engaged in studies during summer. The short window of time where the survey was open (around three weeks) may also have had a negative impact. However, our 52 responses still represents students from second year Computer Science, second year Psychology students, summer research project students, and postgraduate students (mostly PhD students) from a variety of programmes. Data was captured by Microsoft Forms and was stored within Microsoft Forms itself. We manually extracted the research responses into Microsoft Excel to facilitate a more simplified approach to data manipulation and statistical analysis. While Microsoft Forms provides a very feature rich interface for creating complex surveys and questionnaires, we found that it was difficult and time-consuming to extract the response data for further analysis.

4   RESULTS AND DISCUSSION

There were 52 responses. Two questions, which were only available if the student indicated that they have previously used ChatGPT before, had 41 responses each indicating very wide exposure to ChatGPT amongst respondents. Interestingly, one question (number 10), which was only available if the student indicated that they have previously used other digital tools for learning, had 20 (38%) responses. We speculate that this may indicate that some students do not, yet, consider ChatGPT as a digital tool to support their learning. The final question of the survey was an optional question allowing students to provide, with open text, any additional points the students would like to provided. There were 17 (32%) of valid responses here.

Almost 80% of respondents indicated that they had used ChatGPT in the past few months. The majority of these respondents said that this usage was only "occasional" or "sometimes". Types of usage included: as a means of providing further explanation on lecture notes, finding supplementary learning resources, searching on "niche topics", and taking advantage of the fact that ChatGPT appeared to provide unlimited access to educational resources without the obstructions of various paywall systems. Other notable additional observations from the responses included: 81% of respondents supported the statement that "ChatGPT is going to change education" whilst 56% of respondents supported the statement that "ChatGPT will be a useful tool in their education" while 77% of respondents believe that "ChatGPT is going to change how students learn". Interestingly, and something of an important note for educators, 58% of respondents felt that they were not familiar with their University's current policies on ChatGPT.

As mentioned above, a major restriction of this survey and the data it provides was the difficulty in gathering opinions of such a large and diverse population of University students outside of university term. Ideally, this survey (or a similar one) would be repeated with a more representative sample of the whole population by including more respondents and also more students from different courses and departments. A higher response rate from the students would also further validate the information and include more students' voices, which is one of the main aims of this study and paper. The timing of our study had an impact on responses, as described above. However, we also felt that many respondents were unsure of the overall potential of ChatGPT because, at the time of the survey, it was still a relatively new technology within their teaching and learning journeys. Having been unveiled in November 2022 most students will only have encountered one semester (January - June 2023) where ChatGPT existed as a publicly accessible tool for both educators and learners.

5   DISCUSSION AND CONCLUSIONS

Few studies, so far at the time of writing, have focused on students' opinions around the use of ChatGPT in their learning and education. This paper has attempted to address this gap by gathering students responses to a survey on this topic and also surveying some of the recent literature in this area. We found that our student respondents were "interested in using it" and "interested in it as a concept". Several respondents remarked, in open answers, that they were curious how it would help students with mathematical and STEM studies. Overall, there was a feeling among students that the use of this AI should not "remove the humanity and effort from work, studies, and writing". It appeared, as one remark stated, that current usage of ChatGPT and similar tools would be "commensurate with the usefulness of ChatGPT for particular modules and learning tasks". A constant theme within the open text feedback from our survey was that of requiring both teachers and AI systems, such as ChatGPT, to provide timely and helpful feedback on assessment and learning. Dai et al. [5] showed ChatGPT's ability to generate more readable feedback with greater consistency, which assists students in understanding the feedback and thus encourages their actions for improvement. The use of ChatGPT in this way could lead to Boud and Molloy [3]'s idea of sustainable feedback which shifts from the provision of feedback to the design of appropriate learning environments which include or disallow ChatGPT. Instruction in the classroom often suffers from a uniformity of approach that is not always appropriate or optimal for every student. With educational AI, there is potential for personalizing the learning experience to assist students more individually in comprehending complex concepts and processes.

We found, overall, that students highly value their interactions with their teachers and peers. This aligns with the work of Fuchs [8] and others who urge the use of LLMs and chatbots "as a supplement to, and not as a replacement for, human interaction". Student respondents also felt confused about where they could use ChatGPT without negative repercussions. At present, in these early stages of ChatGPT in the classroom, guidelines for usage are most likely provided at a per module or per class basis. However, it is crucial that educational institutions should also develop guidelines and ethical

frameworks for the use of these technologies ensuring that student privacy is protected, bias is minimized, and the learning needs of students are given maximum priority and resources [12, 14]. AI is a controversial topic in education at the moment [4] and it is vital that information about AI is given to everyone in academic settings so they can understand for themselves the implications of usage. As Yilmaz and Karaoglan Yilmaz [26] and others have stated, as more and more discussion happens around ChatGPT and its implications in education, it is vital that students' voices are included in the these discussion discussions. As was evident in our survey responses, in many ways, third level students are potentially the generation currently most impacted by the arrival of these types of tools. They are also the generation which could be most impacted in the future by this disruptive innovation.

In terms of future work, it will be necessary to assess student usage of ChatGPT and other AI tools going forward. Module and programme surveys could be used to include these types of questions. This could be helpful in understanding how students are using these technologies. Our respondents seem to report that ChatGPT was good for "generating ideas at the surface level" but many times the information provided required "further verificatoin". However, some respondents did find it useful for "code debugging and explanations for programming concepts". This highlights that understanding ChatGPT usage amongst students will required a nuanced approach around different subjects and disciplines [8]. The different types of learning styles and needs of students must also be an integral part of these investigations. Exploring the impact of ChatGPT use on students learning around examination and assessment performance would be an important and interesting, but challenging, undertaking for future work.

ACKNOWLEDGEMENTS

REFERENCES

[1] Rajesh Bhayana, Satheesh Krishna, and Robert R. Bleakney. 2023. Performance of ChatGPT on a Radiology Board-style Examination: Insights into Current Strengths and Limitations. *Radiology* 307, 5 (2023), e230582. https://doi.org/10.1148/radiol.230582 arXiv:https://doi.org/10.1148/radiol.230582 PMID: 37191485.

[2] Ali Borji. 2023. A categorical archive of chatgpt failures. *arXiv preprint arXiv:2302.03494* (2023).

[3] David Boud and Elizabeth Molloy. 2013. Rethinking models of feedback for learning: the challenge of design. *Assessment & Evaluation in higher education* 38, 6 (2013), 698–712.

[4] Lijia Chen, Pingping Chen, and Zhijian Lin. 2020. Artificial intelligence in education: A review. *Ieee Access* 8 (2020), 75264–75278.

[5] Wei Dai, Jionghao Lin, Hua Jin, Tongguang Li, Yi-Shan Tsai, Dragan Gašević, and Guanliang Chen. 2023. Can Large Language Models Provide Feedback to Students? A Case Study on ChatGPT. In *2023 IEEE International Conference on Advanced Learning Technologies (ICALT)*. 323–325. https://doi.org/10.1109/ICALT58122.2023.00100

[6] Nino Fijačko, Lucija Gosak, Gregor Štiglic, Christopher T Picard, and Matthew John Douma. 2023. Can ChatGPT pass the life support exams without entering the American heart association course? *Resuscitation* 185 (2023).

[7] Yong Zhi Foo, Rose E. O'Dea, Julia Koricheva, Shinichi Nakagawa, and Malgorzata Lagisz. 2021. A practical guide to question formation, systematic searching and study screening for literature reviews in ecology and evolution. *Methods in Ecology and Evolution* 12, 9 (2021), 1705–1720. https://doi.org/10.1111/2041-210X.13654 arXiv:https://besjournals.onlinelibrary.wiley.com/doi/pdf/10.1111/2041-210X.13654

[8] Kevin Fuchs. 2023. Exploring the opportunities and challenges of NLP models in higher education: is Chat GPT a blessing or a curse?. In *Frontiers in Education*, Vol. 8. Frontiers, 1166682.

[9] Aidan Gilson, Conrad W Safranek, Thomas Huang, Vimig Socrates, Ling Chi, Richard Andrew Taylor, David Chartash, et al. 2023. How does CHATGPT perform on the United States Medical Licensing Examination? the implications of large language models for medical education and knowledge assessment. *JMIR Medical Education* 9, 1 (2023), e45312.

[10] Celbert Mirasol Himang, Samuel Villa Jr, Neljun Espedilla Mayorga, Nelson Fuentes Nolon, Gregorio Pajaron Jr, Engezbent Mirasol Himang, et al. [n. d.]. Understanding the Dynamics of ChatGPT Adoption Among Undergraduate Students: Dataset from a Philippine State University. *Pajelleno and Himang, Engezbent Mirasol, Understanding the Dynamics of ChatGPT Adoption Among Undergraduate Students: Dataset from a Philippine State University* ([n. d.]).

[11] Levente Juhász, Peter Mooney, Hartwig H Hochmair, and Boyuan Guan. 2023. ChatGPT as a mapping assistant: A novel method to enrich maps with generative AI and content derived from street-level photographs. *arXiv preprint arXiv:2306.03204* (2023).

[12] Enkelejda Kasneci, Kathrin Seßler, Stefan Küchemann, Maria Bannert, Daryna Dementieva, Frank Fischer, Urs Gasser, Georg Groh, Stephan Günnemann, Eyke Hüllermeier, et al. 2023. ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and individual differences* 103 (2023), 102274.

[13] Gerd Kortemeyer. 2023. Could an artificial-intelligence agent pass an introductory physics course? *Physical Review Physics Education Research* 19, 1 (2023), 010132.

[14] Michael Liebrenz, Roman Schleifer, Anna Buadze, Dinesh Bhugra, and Alexander Smith. 2023. Generating scholarly content with ChatGPT: ethical challenges for medical publishing. *The Lancet Digital Health* 5, 3 (2023), e105–e106.

[15] Amarachi B Mbakwe, Ismini Lourentzou, Leo Anthony Celi, Oren J Mechanic, and Alon Dagan. 2023. ChatGPT passing USMLE shines a spotlight on the flaws of medical education. , e0000205 pages.

[16] Silvia Milano, Joshua A McGrane, and Sabina Leonelli. 2023. Large language models challenge the future of higher education. *Nature Machine Intelligence* 5, 4 (2023), 333–334.

[17] Philip Mark Newton. 2023. ChatGPT performance on MCQ-based exams. (2023). https://doi.org/sytu3

[18] John V Pavlik. 2023. Collaborating with ChatGPT: Considering the implications of generative artificial intelligence for journalism and media education. *Journalism & Mass Communication Educator* 78, 1 (2023), 84–93.

[19] Jürgen Rudolph, Samson Tan, and Shannon Tan. 2023. ChatGPT: Bullshit spewer or the end of traditional assessments in higher education? *Journal of Applied Learning and Teaching* 6, 1 (2023).

[20] Emma Sabzalieva and Arianna Valentini. 2023. ChatGPT and artificial intelligence in higher education: quick start guide. (2023).

[21] Malik Sallam. 2023. ChatGPT utility in healthcare education, research, and practice: systematic review on the promising perspectives and valid concerns. In *Healthcare*, Vol. 11. MDPI, 887.

[22] Ioannis Skalidis, Aurelien Cagnina, Wongsakorn Luangphiphat, Thabo Mahendiran, Olivier Muller, Emmanuel Abbe, and Stephane Fournier. 2023. ChatGPT takes on the European Exam in Core Cardiology: an artificial intelligence success story? *European Heart Journal-Digital Health* 4, 3 (2023), 279–281.

[23] Eric Strong, Alicia DiGiammarino, Yingjie Weng, Preetha Basaviah, Poonam Hosamani, Andre Kumar, Andrew Nevins, John Kugler, Jason Hom, and Jonathan H Chen. 2023. Performance of ChatGPT on free-response, clinical reasoning exams. *medRxiv* (2023). https://doi.org/10.1101/2023.03.24.23287731

[24] Nigar M Shafiq Surameery and Mohammed Y Shakor. 2023. Use chat gpt to solve programming bugs. *International Journal of Information Technology & Computer Engineering (IJITC) ISSN: 2455-5290* 3, 01 (2023), 17–22.

[25] Devin Ormsby Williams and Elisa Fadda. 2023. Can ChatGPT pass Glycobiology? *bioRxiv* (2023), 2023–04.

[26] Ramazan Yilmaz and Fatma Gizem Karaoglan Yilmaz. 2023. Augmented intelligence in programming learning: Examining student views on the use of ChatGPT for programming learning. *Computers in Human Behavior: Artificial Humans* 1, 2 (2023), 100005. https://doi.org/10.1016/j.chbah.2023.100005