

This item was submitted to [Loughborough's Research Repository](#) by the author.
Items in Figshare are protected by copyright, with all rights reserved, unless otherwise indicated.

Conversational intelligent tutoring systems for online learning: what do students and tutors say?

PLEASE CITE THE PUBLISHED VERSION

<https://doi.org/10.1109/EDUCON52537.2022.9766567>

PUBLISHER

IEEE

VERSION

AM (Accepted Manuscript)

PUBLISHER STATEMENT

© 2022 IEEE. Personal use of this material is permitted. Permission from IEEE must be obtained for all other uses, in any current or future media, including reprinting/republishing this material for advertising or promotional purposes, creating new collective works, for resale or redistribution to servers or lists, or reuse of any copyrighted component of this work in other works.

LICENCE

All Rights Reserved

REPOSITORY RECORD

Ji, Siyuan, and Tangming Yuan. 2022. "Conversational Intelligent Tutoring Systems for Online Learning: What Do Students and Tutors Say?". Loughborough University. <https://hdl.handle.net/2134/21594261.v1>.

Conversational Intelligent Tutoring Systems for Online Learning: What do Students and Tutors Say?

Abstract— As a futuristic Technology Enhanced Learning concept, a conversational Intelligent Tutoring System in an e-learning context, is gradually becoming realistic thanks to the continuous advancement in Artificial Intelligence and to the worldwide increasing demand in online learning, especially during the pandemic time. However, is such a conversational technology going to support student learning or is it going to make learning more difficult? In the absence of a matured conversational Intelligent Tutoring System, this work aims at addressing this question indirectly through an investigation of how students and tutors in an online learning programme perceive the concept of conversational Intelligent Tutoring System, such as a chatbot, for online learning. This is achieved by surveying students who are currently enrolled in an online programme and interviewing the tutors on the same programme. The research concludes that ITS would very likely enhance online learning experience for both students and tutors, but there are various concerns that must be addressed.

Keywords— Artificial Intelligence, Chatbot, Intelligent Tutoring System, Online learning, Technology Enhanced Learning

I. INTRODUCTION

The concept of Intelligent Tutoring Systems (ITS), first implemented in the mid-1980s [1], together with the first realisation of distance learning via internet by Jerrod Maddox in 1995 [2], marked the beginning of a new pedagogical era where education moves away from traditional classroom teaching into a virtual and intelligent learning environment.

The functionalities that an ITS could offer nowadays flourishes with the continuous advancement in Artificial Intelligence (AI) technologies. Filled with theoretical studies in relevant pedagogical areas, the scope of ITS further evolves into the concept of pedagogical agents, where the roles of an AI agent in a virtual learning environment are not restricted to an instructive and responsive tutor, but also extended to learning companions [3] such as a co-learner [4] that mimics a student behaviour to enhance interactivity and a teachable agent [5] to be taught by the students to enable ‘learning from teaching’. Backed by the vast amount of pedagogical study in pedagogical agents and research and development in AI technology, it would not be long until these ‘intelligent tutors’ becoming an indispensable element in any form of teaching.

In parallel, the ever-growing demand in online learning from national students for reasons such as flexible and part-time study and international students for reasons such as cost management has been widely acknowledged in higher education [6]. This has triggered various distance learning initiatives among the universities in the UK and the development of massive open online courses worldwide. Furthermore, there was also the unforeseen boost of such a demand from both national and international students due to the recent breaking out of coronavirus that have led to a national-wide lockdown [7].

ITS, specifically of a conversational type, and online learning seems to be a natural match, where ITS can support student learning remotely when tutor availability is limited. Many ITSs have been designed in ways to improve student learning experience. In an online learning context, the agent-based ITS designed by Phobun and Vincheanpanya [8] adapts itself to match the learning ‘rhythm’ of the user by adjusting the amount of information feedback to the student based on their learning performance. Along similar lines, Carayannopoulos’ study [9] has shown that chatbot has the capability to manage information overload and enhance social connectivity. Although the study primarily targets at first year undergraduates that is not in an online learning setting, information overload and social distance are clearly issues faced by online students during the early phases of the programme [10]. Another interesting usage of conversational ITS is to chat in a first personal tone to mimic a founding figure in a discipline; thereby allowing students to interact with the ITS to learn the theories directly from the ‘figures’. The novel pedagogical usage of ITS has proven to be more fun and engaging than textbook reading [11].

There are also concerns with the usage of such kinds of ITS. Despite the popular usage of conversational ITS, e.g. chatbots, to support second language study [12, 13], analysis has shown that these technologies lack “emotion, visible cues and ability to confirm understanding” [14], thereby generating unnecessary frustration that could outweigh the benefits they bring. While being fun to use in some learning context, study on Feudbot [15] also suggests that the learning can be shallow hence being insufficient to address learning objectives that are at the higher levels in Bloom’s Taxonomy.

Despite the long history of technical development and pedagogical study of ITS, there are still many research gaps in understanding their educational impacts [16]. This is even more so when dealing with conversational ITS to be used in the context of online learning and at a scale of throughout the entire programme. For questions at large, will such an ITS used enhance student learning experience, or will it just be used more as a marketing strategy? For questions at small, following the argument made by Savin-Baden, Tombs and Bhakta, can trust and personalisation of such an ITS be established [17]? The lack of studies in this area can be primarily attributed to the lack of ITS-based online programmes in existence. As such, investigating the pedagogical benefits and concerns of an ITS-based online programme can be challenging.

Under the same constraint, this work aims at addressing this challenge by firstly treating a conversational ITS used in online programmes simply as an ordinary Technology Enhanced Learning (TEL) concept, but with additional non-conventional considerations. This allows the application of existing studies and frameworks on TEL, specifically, the work by Dror to analyse ITSs [18]. This first step has led to the inclusion of human tutors into the ‘equation’ in addition to students in studying the pedagogical impact of an ITS in

online learning. The work then qualitatively studies perceptions of such an ITS from both the students and human tutors as an indirect means to analyse whether ITS would promise better learning experience. For example, it is intuitive that a student who claims to be willing to engage with certain functionalities (e.g., assessing level of understanding on a topic) of the ITS, indicates a good chance that ITS would enhance student engagement. On the other hand, student who generally repels the use of new technologies in learning would unlikely engage with ITS. Perceptions acquired from different groups are then synthesised into a concrete summary to answer the research question.

The rest of this work is organised in the following way: Section II proposes the research question and explain in detail how the research question will be investigated indirectly in the absence of a mature conversational ITS. Section III provides the research data and a detailed analysis for the data. Section IV synthesise the analysis into concrete conclusions that answers the research question and provides an account on the limitations of the findings. Finally, the article will be concluded in Section V with an outline of possible future works.

II. RESEARCH QUESTION AND METHODOLOGY

This work aims at exploring the following specific research question:

Would a conversational ITS enhance student engagement in the context of online learning?

This research question is considered as a refinement of the broader question on the pedagogical impact of an ITS used in online learning. Apart from limiting the scope for feasible research at scale, the primary reason for such a refinement is to specifically address the issue that remote delivery often results in less student engagement and collaborative learning [19]. The answer to the research question has the immediate benefit of confirming whether conversational ITS could contribute to better student engagement in online learning; thereby support programme developers to consider investing in the development of an ITS for existing online programmes.

Ideally, this research question would be addressed through experiments that are designed with students engaging with a conversational ITS deployed for an online programme. However, as an experiment of such kind is not feasible without an existing, programme-wide ITS, an alternative approach to investigate the research question in the absence of such an ITS is required. This work therefore proposes to tackle the question indirectly by investigating how a conversational ITS used in online learning is perceived by targeted audiences with a pedagogical focus on whether the ITS would make learning more engaging. Specifically, this amounts to a qualitative, but ‘speculative’ study seeking personal opinions toward an ITS being used in an online learning environment. ‘Speculative’, in this context, refers to the fact that target audience is unlikely to have experience in engaging a conversational ITS in this context, and therefore, the opinions provided are considered speculative.

Furthermore, inspired by how public perception of autonomous vehicle is studied by Hilgarter and Granig [20], this work conveys the idea of a generic chatbot (a piece of software that enables online conversations) playing the role of an ‘intelligent tutor’, as a potential implementation of a

conversational ITS to the target audiences to help them establishing a baseline for the ITS technology. As chatbot is nowadays a commonly used technology in many domains, it is likely that the audiences will have some experiences in engaging with chatbots that are used for different purposes and at different level of intelligence. This allows the audience to imagine how a conversational ITS would work in the context of online learning and to establish different levels of expectations based on personal experiences. For simplicity, chatbot and conversational ITS will be used interchangeably in the rest of the work.

The choice of the targeted audiences is derived based on Dror’s study on TEL [18]. Despite being an advanced concept, the usage of a chatbot in the context of online learning still fell in the category of Technology Enhance Learning (TEL). This is because the primary purpose of such a usage in the pedagogical sense is to support learning activities, which is indifferent to any other ordinary TEL, no matter how basic they seem, for an example, a PowerPoint-based presentation. In Dror’s description of a TEL ‘equation’, technology, learning materials and learners are namely the three important parameters to ensure enhanced learning experience; and the efficiency and effectiveness of a TEL can be measured by his three C’s of learning: Control, Challenge and Commitment. Intuitively, this makes students currently undertaking an online programme a suitable audience for this study as they will be the ‘learners’ in the TEL equation and the three C’s are anticipated to be measured based on their engagement with the chatbot. However, this does not consider the non-conventional part of a chatbot compared with ordinary TEL technologies. Without elaborating into much of the technical details, chatbot that uses machine learning techniques, are considered ‘learners’ themselves which learns from data generated by users. In this case, human tutors must be included into the picture as it is expected that chatbot, acting as a pedagogical agent, will engage and be engaged by human tutors in the machine learning processes. Therefore, the proposed qualitative study is divided into two parts with the first part targeting at students who are currently enrolled under the online programme offered by the Department of Computer Science, the University of York, and with the second part targeting at human tutors who are currently tutoring under the same online programme.

The first part of the study is in the form of a questionnaire consisting of 7 questions, as provided in Appendix I. Based on earlier discussion, this questionnaire is designed to have two sections. The first section aims at acquiring students’ perceptions of chatbots used in a generic context while the other section seeks perceptions of chatbots in the specific context of online learning. Format of the questions is mostly close-ended multiple choices with cases where student could provide additional or alternative answers that are not originally provided in the given choices. As the aim of this questionnaire is to seek opinions from the students, most of the answers to the questions are formulated in a psychological measure. However, it is unclear whether the quantification of the response would result in any statistically meaningful data. Therefore, Likert Scale is avoided to provide participants the opportunity to go through the given choices and select the most appropriate one. Nonetheless, the answers can be translated into an equivalent (but non-uniform across the questions) Likert Scale if necessary. Although the answers offer a reasonably good range of degree in the perspective, it is acknowledged that participants do not have a normalised

baseline. For instance, what one may consider as 'sufficient', may be considered to be as 'insufficient' by another participant.

The second part of the study is in the form of a casual interview against individual tutor participants who are part of the online tutoring team. The interview contains a list of initial questions as outlined in Appendix II. These questions aim to prompt interviewees to provide their speculations on the potential pedagogical benefits and concerns over a chatbot used for online learning; thereby allowing informative implications on whether tutors believe ITS could enhance online learning experience or not to be made.

Following the analysis of the acquired qualitative data, the research will conclude by synthesising the perceptions from different perspectives to eventually provide answer to the research question proposed.

III. ANALYSIS OF RESULTS

A. Student Perspective

The student survey has attracted 98 valid responses in total. The responses for all the questions are pictorially presented in Figure 1 in Appendix III. The following observations and analyses have been made.

For the first part of the questionnaire, firstly, despite the fact that chatbot technology has been widely deployed in various context, it is observed that the sample only shows somewhat limited experience in engaging with chatbot services, with only one-fifth of the participants claiming having 'many' experiences in using chatbots. Further, the responses for Q2 and Q3 suggest that chatbots generally give a more 'mechanical' feeling as opposed to an 'intelligent' feeling but are still somewhat useful with less than one-third of the participants finding chatbots are not useful. The results are expected given that natural language processing is still an evolving discipline, and we are far from artificial general intelligence; hence, the intelligence and usefulness of any chatbot technology are limited to technology advancement. Interestingly though, there is a statistically significant linear relationship ($r=0.59$, $p<0.001$) between the response to Q2 and Q3, indicating that the intelligence of a chatbot positively correlates to its usefulness. As such, it seems that participants find a more intelligent chatbot to be more useful. Finally, data of Q4 shows that slightly more than half of the participants would like to actively engage with a chatbot when available to them, suggesting a two-sided attitude toward chatbot in general. Using Pearson correlation measure again, it is found that there is a statistically significant linear relationship ($r=0.516$, $p<0.001$) between the response to Q3 (usefulness) and Q4 (general attitude), but not between Q2 (intelligence) and Q4. This can be interpreted as participants who find chatbots useful in their previous experiences would likely engage with new chatbots; and the intelligence of the chatbot, in comparison, is not as important in shaping participants attitude toward chatbot services.

For the second part of the questionnaire, as in Q5, it is observed that only less than one-fifth of the participants have a certain negative view and more than half of the participants hold a certain positive view on chatbot being able to increase their engagement in online learning. Given the two-sided attitudes (with almost 50/50 split) toward chatbot in general observed previously (Q4), the outcome of Q5 suggests that a chatbot in an educational context, specifically online learning,

is likely to be a promising and attractive idea to the students. In addition, for participants who have responded (c) 'avoid unless...' and (d) 'avoid under...' in Q4, about one-third of these participants have a positive view on chatbot for an online programme; and none of the participants who have chosen (a) 'would like to engage' and (b) 'would like to give them a try' in Q4 has a negative view on chatbot for an online programme. Undoubtedly, there are about one-third of the participants who have chosen (c) 'neither likely nor unlikely' for Q5 despite what they have chosen in Q4. Therefore, to establish a more meaningful correlation, a larger sample size would be evidently necessary.

Questions Q6 and Q7 are specifically multiple answers questions where participants could select as many functions as they desire from chatbot and as many concerns as they may have over the chatbot.

Most of the proposed functions in Q6 are targeting at typical demands from the students during the delivery of the modules, for examples, verifying understanding of a topic and explaining programming error. As such, these functions evidently attracted more than two-thirds to of the participants. However, these functions require less 'intelligence' compared to the other two proposed functions which are 'ease me when I am stressed during the study' and 'help me to formulate a study plan'. As shown in the figure (Figure 1, subfigure 6) in Appendix III, these two functions are much less attractive. This outcome is sensible given that these functions are unlikely to be considered primary or necessary for a chatbot used in an educational context; and on top of that, there are also privacy concerns since the two functions would also require users to provide sensitive information to the bot. Nonetheless, this outcome does challenge one of the earlier analyses on the correlation between Q2 and Q3, i.e. whether a more intelligent chatbot would be more useful? Clearly, in this case, the additional intelligence brought by the two latter functions do not necessarily make the chatbot more useful. Another observation worth mentioning is that for those who have chosen these two more intelligent functions, only a very small portion of them have mentioned that 'data monitoring and privacy' is of a concern as in Q7.

There are two particularly functions that have been proposed by the participants more than once. One function is to determine student's areas of strength and weakness to allow the bot feeding tailored resources to the student. This is essentially a function that builds upon proposed functions (c) 'to verify whether...' and (d) 'to create mock tests...'. The other function is about making the chatbot facilitating multi-agent conversations where tutors and students who have similar questions asked to the bot are brought together to have a conversation with the involvement of the bot as a facilitator.

For concerns of a chatbot used in online learning, as in Q7, reliability of the chatbot and unavailability of tutors stood out among the proposed five concerns (note that 'other' concerns proposed by the students are more or less extensions of what has been listed in the question). The first concern of the two is associated with technical challenges faced by any chatbot service and aligns with participants feeling toward chatbots as in part 1 of the questionnaire. The second concern is a worry that has been anticipated but can be managed by a careful design of the programme delivery methods. However, this raises a major issue with incorporating a chatbot for online programme: what are the pedagogical objectives of the chatbot in an online programme? Without proper definition in

the development stage, it would likely lead to a misleading view in which the chatbot is regarded as a 'replacement' of the human tutor.

The followings highlight the most interesting and important observations from the student responses:

- Participants with limited experience in engaging with chatbot services find chatbot, in general, give a more 'mechanical' feeling as opposed to an 'intelligent' feeling.
- Students generally find chatbots being useful to achieve the purpose they are designed for.
- Intelligence of a chatbot seem to positively correlate to its usefulness from students' perspective.
- Participants who find chatbot useful in their previous experiences would likely engage with a conversational ITS; and the intelligence of the ITS, in comparison, is not as important in shaping participants attitude toward conversational ITSs.
- Only less than 1/5 of the participants have a certain negative view, and more than half of the participants hold a certain positive view on conversational ITS being able to increase engagement in online learning.
- Reliability of the ITS and unavailability of tutors are the most worrying concerns for students.

B. Tutor Perspective

The interview questions are designed around tutors' perception toward a chatbot for online learning. However, the actual interviews conducted were not limited to the prompt questions as in Appendix 2. In total, four interviews have been made and the findings are summarised in this section.

The interview results show that all tutors had a positive view over the idea of implementing a chatbot as an ITS for the current online programme. Partly, this is because chatbot can be promising in managing workload, for examples, being able to answer frequently asked questions and avoiding omissions of queries; but more importantly due to it being a fascinating idea both in the technical sense (naturally attractive to computer scientists) and pedagogical sense (promises novel educational capabilities).

Drawing on desired functionalities of the chatbot, there were several interesting ideas being brought up during the conversation. For instance, there was the idea of having a voice over the text (e.g. a voicebot) to make the bot more lively and more engaging. This idea apparently also addresses potential accessibility challenges, for example, in the case where screen reader is needed. There was also the idea of using the chatbot as part of the assessment process to test understanding, monitor plagiarism, provide feedback and perform viva-like assessments.

Despite the positiveness, apart from the concerns that were indicated in the questionnaire to students, there were two additional pedagogical concerns raised by the tutors over the design and usage of the chatbot.

Firstly, elaborating on the reliability issue of the chatbot, there was a major concern on the assurance of the chatbot in general. Due to the immaturity of chatbot and related technologies, the more 'intelligent' functions that the chatbot offers, the more likely it would make 'mistakes' and the harder

it would be to assure its reliability. As such, in the probable situation where a chatbot gives a misleading answer, who should be held responsible? If this error has caused subsequent undesirable scenarios such as student losing marks in an assessment, should the mark deduction be discarded? What would be a reasonable assumption on students' tolerance of such an error? The list of questions continues and reaches out to other dimensions such as ethics and governance.

The second concern, which is perhaps more critical, draws on the idea of using the chatbot as an educational tool to enhance learning experience. If the chatbot is to play a teaching role, the chatbot would be anticipated to have conversations with the user rather than simply providing answers in a Q&A style. There are apparently technical challenges such as understanding the actual intent of the user. The more challenging part of this issue, however, is on how teaching philosophies could be embedded into the teaching functionalities, which certainly requires substantial multi-disciplinary research that involves artificial intelligence, computer science education and pedagogy in general.

Finally, despite the foreseeable challenges in the development of the chatbot and concerns that has been raised, tutors are generally excited about the idea and are willing to participate in the development from various angles.

IV. SYNTHESIS OF THE RESEARCH FINDINGS

To summarise perceptions from students, based on the observation and analysis of the responses, despite various concerns that the students may have over the maturity of existing conversational ITS and the usage of such an ITS, e.g., chatbot, in an online learning context, it is clear that a majority of the students are in favour of the idea of being able to engage with a chatbot as part of their learning experience under the online programme. The level of engagement is proportionate to the level of maturity of such a conversational ITS, where an ITS offering more sophisticated and advanced functionalities would likely be more engaging.

To summarise perceptions from tutors, the interview results though indicate a favourable answer in conversational ITS being able to enhancing student engagement, raises more pedagogical concerns such as knowledge assurance and learning activity design. Diving a bit deeper, these concerns are arguably rooted in the technical challenges in developing a conversational AI that can support teaching.

Synthesising the summaries above, the answer to the research question, *would a conversational ITS enhance student engagement in the context of online learning*, is certainly anticipated to be affirmative. However, to what degree the engagement can be enhanced, the findings suggest that this would be proportionate to the technical and pedagogical design efforts given to the development of the ITS for online learning. It is important to empathise that this latter conclusion is only indicative and not conclusive, due to the 'speculative' nature of the studies conducted in this work.

There are certainly limitations to the conducted research which in turn would affect the research findings, but unlikely to be at large. The main limitation in this work is that the student survey is limited to 'student/tutor expectation' as opposed to 'student/tutor experience' on a chatbot for online learning. As such, the findings are considered indirect and implied. To improve, it would be useful to use an openly available educational chatbot to design a constrained, simple

learning environment for participants to test the conversational ITS and provide feedback. This would generate direct evidence to support or invalidate the conclusion derived from the studies conducted in this work. However, such kinds of experimentation rely on how ‘engaging’ the chatbot would be. It might be difficult to conclude whether the enhancement in learning is rooted in the good design of the conversational ITS, a good design of the learning activity initiated by the ITS, or the concept of ITS used in online learning itself. Other limitations include: (i) the use of a chatbot as a substituting concept of a conversational ITS, though helping participants to ‘visualise’ what a conversational ITS would look like, could possibly mislead certain participants in what can be expected based on their personal experience with using chatbots; (ii) limited sample size in that both number of survey participants and interviewees are considered insufficient to establish credible statistical measurements. The statistical measures observed though appear to be intuitive, does require further a much large sample size for confidence; (iii) limited audience group, which is only targeted at Computer Science students, who arguably would have more interest in AI technologies than a more averaged student group.

V. CONCLUSIONS

This work has studied the perceptions of a chatbot (as an implementation of a conversational ITS) used in an online learning environment from two groups of people: students who are currently studying Computer Science at the Master level in an online MSc Programme and tutors who are responsible for the delivery of the modules in the same online MSc Programme. Acquired data on perceptions are analysed and synthesised into a concrete conclusion, which firmly confirms that such a chatbot used for online learning would very likely enhance student engagement to the learning material.

Although this work firmly answers the research question based on the analysis of the data, the route ahead in answering the broader question on whether ITS would enhance learning experiences still requires substantial investigation. Therefore, to improve the formulation and understanding of the research question proposed, a future work would expand the scope and return to Dror’s 3C in measuring the efficiency and effectiveness of TEL to examine the idea of developing and deploying a large-scale ITS for online learning more fully and thoroughly.

In addition to confirming the potential positiveness of the usage of a conversational ITS for online learning, this work also identified several technical and pedagogical concerns, derived from student responses and interviews with human tutors. These can be summarised into three areas: (i) a feeling of ‘intelligence’ and actual usefulness; (ii) assurance of the ITS by developers, tolerance of errors from users, and governance on usage from regulators; and (iii) embedment of educational philosophy and approaches in a conversational ITS on top of the primary teaching functionality. The authors therefore invite readers to investigate these concerns further and work collaboratively to gain better understanding on how to best use conversational ITS as a non-conventional TEL tool to support future online learning.

ACKNOWLEDGMENT

The authors would like to thank the online teaching team in the Department of Computer Science, University of York

for their support to the project and participation in the interview and Dr Lucy Turner-Voakes for her invaluable feedback to the work.

REFERENCES

- [1] Anderson, J.R., Boyle, C.F. and Reiser, B.J., 1985. Intelligent tutoring systems. *Science*, 228(4698), pp.456-462.
- [2] J. Corbeil and M. Corbeil, “E-Learning: Past Present and Future”, in *International Handbook of E-learning*, Volume 1, B. Khan and M. Ally, Ed. Abingdon: Routledge, 2015.
- [3] C. Chou, T. Chan and C. Lin, “Redefining the learning companion: the past, present, and future of educational agents”, *Computers & Education*, vol. 40, no. 3, pp. 255-269, 2003.
- [4] S. Botsios, V. Mitropoulou, D. Georgiou, en I. Panapakidis, “Design of virtual co-learner for asynchronous collaborative e-learning”, in *Sixth IEEE International Conference on Advanced Learning Technologies (ICALT’06)*, Kerkraade, The Netherlands, 2006
- [5] D. B. Chin, I. M. Dohmen, B. H. Cheng, M. A. Oppezzo, C. C. Chase, and D. L. Schwartz, “Preparing students for future learning with Teachable Agents”, *Educ. Technol. Res. Dev.*, vol 58, no 6, pp. 649–669, Des 2010.
- [6] D. Vasilevska, B. Rivza, V. Aleknevičienė, and A. Parlińska, “Analysis of the demand for distance education at eastern and central European higher education institutions”, *J. Teach. Educ. Sustain.*, vol 19, no 1, pp. 106–116, Jun 2017.
- [7] J. Ross, “Race on to create online courses for virus-stranded students “Educational Technology”, People.uis.edu, 2021. [Online]. Available: <https://people.uis.edu/rschr1/et/?p=59848>. [Accessed: 10- Dec- 2021].
- [8] P. Phobun and J. Vicheanpanya, “Adaptive intelligent tutoring systems for e-learning systems”, *Procedia Soc. Behav. Sci.*, vol 2, no 2, pp. 4064–4069, 2010
- [9] S. Carayannopoulos, “Using chatbots to aid transition”, *Int. J. Inf. Learn. Technol.*, vol 35, no 2, pp. 118–129, Mrt 2018.
- [10] M. D. Dixon, “Measuring student engagement in the online course: The Online Student Engagement scale (OSE)”, *Online learn.*, vol 19, no 4, Jul 2015.
- [11] B. Heller, M. Proctor, D. Mah, L. Jewell, and B. Cheung, “Freudbot: An investigation of chatbot technology in distance education”, 2005, pp. 3913–3918.
- [12] S.-K. Choi, O.-W. Kwon, and Y.-K. Kim, “Computer-assisted English learning system based on free conversation by topic”, in *CALL in a climate of change: adapting to turbulent global conditions – short papers from EUROCALL 2017*, Research-publishing.net, 2017, pp. 79–85.
- [13] J. X. Huang, K. S. Lee, O. W. Kwon, and Y. K. Kim, “A chatbot for a dialogue-based second language learning system. *CALL in a climate of change*”. 2017.
- [14] A. Gallacher, A. Thompson, and M. A. Howarth, “My robot is an idiot!”—students’ perceptions of AI in the L2 classroom”. 2018.
- [15] B. Heller, M. Proctor, D. Mah, L. Jewell, and B. Cheung, “Freudbot: An investigation of chatbot technology in distance education”, 2005, pp. 3913–3918.
- [16] R. Winkler and M. Soellner, “Unleashing the potential of chatbots in education: A state-of-the-art analysis”, *Acad. Manag. Proc.*, vol 2018, no 1, pp. 15903, Aug 2018.
- [17] M. Savin-Baden, G. Tombs, and R. Bhakta, “Beyond robotic wastelands of time: Abandoned pedagogical agents and new pedalled pedagogies”, *E-Learn. digit. media*, vol 12, no 3–4, pp. 295–314, Jun 2015.
- [18] I. E. Dror, “Technology enhanced learning: The good, the bad, and the ugly”, *Pragmat. cogn.*, vol 16, no 2, pp. 215–223, Aug 2008.
- [19] J. Paulsen and A. C. McCormick, “Reassessing disparities in online learner Student Engagement in higher education”, *Educ. Res.*, vol 49, no 1, pp. 20–29, Jan 2020.
- [20] K. Hilgarter and P. Granig, “Public perception of autonomous vehicles: A qualitative study based on interviews after riding an autonomous shuttle”, *Transp. Res. Part F Traffic Psychol. Behav.*, vol 72, pp. 226–243, Jul 2020.

APPENDIX I. STUDENT QUESTIONNAIRE

Part 1 - General questions over chatbot technologies:

- 1) Have you had any experience in using any chatbot service?
 - a) a lot
 - b) many
 - c) some
 - d) little
 - e) no
- 2) How would you describe the level of **intelligence** of the chatbot(s) that you have used previously?
 - a) sufficiently intelligent for my need
 - b) intelligent in certain aspects and contexts
 - c) mostly mechanical that give limited feeling of intelligence
 - d) does not seem to be intelligent at all
 - e) others, please specify (put N/A here if (e) was selected in Q1)
- 3) How would you describe the level of **usefulness** of the chatbot(s) that you have used previously?
 - a) sufficiently useful for my need
 - b) useful in certain aspects and contexts
 - c) mostly unhelpful
 - d) not helpful at all
 - e) others, please specify (put N/A here if (e) was selected in Q1)
- 4) What is your current attitude toward chatbots?
 - a) would like to engage with them whenever available to me
 - b) would like to give them a try and then decide
 - c) avoid unless this is an urgency and it is the only source available
 - d) avoid under all circumstances

Part 2 - Specific questions over the online programme at University of York:

- 5) Would you consider the offering of a chatbot service along with the current online programme would increase your engagement with the programme?
 - a) very likely
 - b) likely
 - c) neither likely nor unlikely
 - d) unlikely
 - e) very unlikely
- 6) What are the functionalities that you would like to see from a chatbot developed for the online programme? (select as many as applicable)
 - a) provide answers to simple questions such as deadline of an assessment, definition of terminologies, and where can I find resources for a specific topic
 - b) help me to explain a programming error
 - c) to verify whether I have understood a topic or not
 - d) to create mock tests (including marking of these tests) on areas that I would like to improve

- e) to ease me when I am stressed during the study
 - f) help to organise my study time and plan
 - g) others, please specify
- 7) Do you have any specific worries over a chatbot? (select as many as applicable)
 - a) distraction, e.g. ends up "chatting" rather than engaging for learning activities
 - b) incorrect or misleading answers from chatbot
 - c) reduction in the necessary engagement from human tutors
 - d) data monitoring and privacy
 - e) others, please specify

APPENDIX II. TUTOR INTERVIEW QUESTIONS

The following questions are asked during the interview with human tutors working under the online programme. There is no specific order for how these questions are asked.

- How do you like the idea of having a chatbot that acts as an intelligent tutor to help your daily work?
- What are the functionalities of the chatbot that you would like to see?
- What are your concerns over the chatbot?
- Would you be interested in participating the research and development of a chatbot for the online programme?

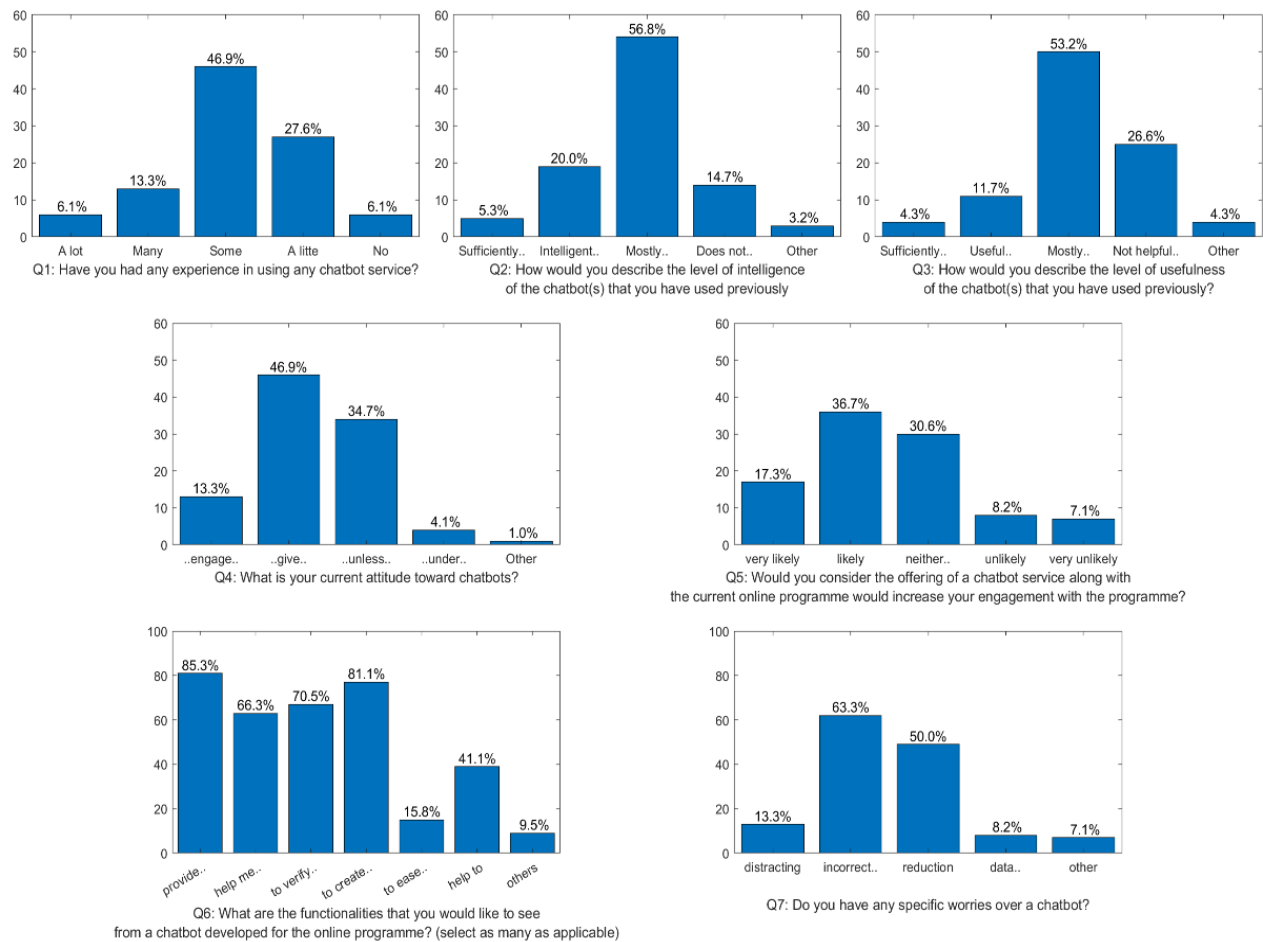


Figure 1 Student responses to the questionnaire.

APPENDIX III. STUDENT QUESTIONNAIRE DATA SUMMARY BY QUESTION

Student responses to each question of the questionnaire are summarised in the bar graphs in Figure 1.