

The design and implementation of a pilot chatbot in distance education

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Resumo: Este artigo apresenta o design e a implementação de um chatbot em dois cursos de licenciatura numa Universidade de Ensino a Distância (EaD) em Portugal, utilizando um software de desenvolvimento de chatbots. O objetivo é abordar a seguinte questão de investigação: como pode um chatbot ajudar as equipas de coordenação de curso a gerir o crescente volume de pedidos de informação nos seus cursos de EaD? O artigo está dividido em duas partes. Na primeira parte, detalha-se o desenvolvimento de um chatbot utilizando o Melibo e descrevem-se os métodos empregues para criar a ferramenta. Na segunda parte, apresentam-se os resultados preliminares de um questionário administrado aos estudantes nesses dois programas, com o objetivo de recolher as suas perceções sobre o uso de chatbots como assistentes virtuais. Os resultados preliminares do questionário (n=119) indicam que, enquanto metade dos participantes está ciente do potencial dos chatbots, apenas um pequeno grupo os utilizou de facto. A

maioria dos inquiridos manifesta concordância relativamente à capacidade dos chatbots em contribuir para o esclarecimento de dúvidas no âmbito das coordenações de cursos. Interrogados sobre a possibilidade de os estudantes recorrerem a assistentes virtuais como suporte às suas atividades académicas, 62% dos participantes revelaram-se favoráveis à ideia. Em contraste, 15% posicionaram-se contra a adoção desta ferramenta nos seus processos de aprendizagem.

Palavras-chave: Chatbots; Inteligência Artificial; Ensino a Distância

Abstract: This article presents the design and implementation of a chatbot in two undergraduate programmes at a Distance Learning University in Portugal, using a chatbot development software. The study aims to address the question: how can a chatbot help course teams to manage the growing volume of information requests in distance education courses? The article is divided into two parts. In the first part, the development of a chatbot using Melibo is detailed, describing the methods employed to create such a tool. In the second part, preliminary results of a questionnaire delivered to students in these two programmes are presented, aiming to gather their perceptions on the use of chatbots as virtual assistants. The preliminary results of the questionnaire (n=119) indicate that while half of the participants are aware of the potential of chatbots, a smaller portion have actually used them. Most respondents agree that chatbots can help clarify academic or administrative questions related to the course. When asked if students would consider using virtual assistants to support their academic activities, 62% of respondents expressed agreement with this idea, while 15% are against integrating this tool into their learning routine.

Keywords: Chatbots; Artificial Intelligence; Distance Learning

Setting the scene

Distance education students historically face numerous challenges when adapting to a learning mode characterised by its asynchronous nature and heavy reliance on learning communities and virtual communication channels. The flexibility of space and time, which are key advantages of distance education, can sometimes exacerbate feelings of isolation, disorientation, and demotivation, often leading to dropout rates. This issue has become even more pronounced in recent years due to the high demand for higher education programmes, placing significant pressure on higher education institutions. Despite the surge in student numbers, there has not been a corresponding increase in funding or academic staff, resulting in a higher student-to-teacher ratio (Nicol & Macfarlane-Dick, 2006). Consequently, the support provided by departments and programme coordinators has been significantly reduced, contributing to ineffective learning outcomes and a high dropout rate (Brinton et al., 2015; Hone & El Said, 2016).

Effective and timely communication among students, academics, and support staff stands as a pivotal factor in fostering student engagement, motivation, and overall academic success, while also alleviating feelings of isolation. However, the burgeoning enrollment in distance education programmes has strained institutions' capacity to maintain personalised one-to-one communication with students. Despite numerous proposed solutions, many face implementation hurdles due to financial and organisational constraints (Winkler & Söllner, 2018). This challenge permeates across institutional support services, programme administrative teams, lecturers, and tutors.

A recent strategy to address this issue involves the integration of artificial intelligence, specifically chatbots, to assist institutions in tackling these communication challenges. Incorporating chatbots into education yields benefits such as instant assistance, rapid access to information, enhanced learning outcomes, and enriched educational experiences. These tools have the potential to address a range of issues, particularly by providing personalised and timely support to individual students' needs (Winkler & Söllner, 2018). Nonetheless, there

is a risk of chatbots providing incorrect responses or failing to comprehend queries, potentially leading to frustration or misinterpretation. Moreover, acquiring the skill to effectively interact with a chatbot is often overlooked, as is managing expectations regarding the capabilities of such tools. Mastery of these skills is essential to fully harness the potential benefits offered by chatbots.

The paper introduces the development and implementation of a chatbot aimed at enhancing communication between the programme course team and students enrolled in two programmes at a Distance Learning University: the undergraduate programme in Engineering Informatics and the undergraduate programme in Education. The paper will detail the methodology used to create the chatbot and present findings from a preliminary study conducted among students in these two programmes.

Literature review

Chatbots offer a myriad of advantages in education. Firstly, they provide immediate assistance, ensuring prompt responses to student queries. Secondly, they offer personalised support, catering to individual learning needs and preferences. Additionally, chatbots facilitate round-the-clock availability, overcoming time constraints and enhancing accessibility to resources and information. Moreover, they promote engagement through interactive conversations, fostering active participation and stimulating learning. Furthermore, chatbots can alleviate the burden on educators by handling routine inquiries, allowing them to focus on more complex tasks. Lastly, they offer scalability, accommodating large student populations without compromising quality, thus optimizing educational experiences in a cost-effective manner (Labadze, Grigolia & Machaidze, 2023).

Research suggests that chatbots can have a substantial impact on students' learning outcomes, whether by bolstering argumentation skills or by fostering increased engagement and enhanced comprehension of complex subjects (Wambsganss, Janson & Leimeister, 2022; Guo, Zhong & Chu, 2023). Additionally,

studies indicate that both bot engagement and individual user characteristics play pivotal roles in shaping student satisfaction with chatbots in educational settings (Chocarro, Cortinas & Marcos, 2021).

Deng and Yu (2023) discovered that while chatbots had a notable and positive impact on various learning-related facets, they did not substantially enhance student motivation. The authors suggested that benefits of learning such as critical thinking, argumentation, resilience, or increased autonomy may be facilitated by chatbots. However, their study did not identify a significant improvement in student engagement or motivation attributed to chatbot usage.

Conversely, Okonkwo and Ade-Ibijola (2021) and Rapp, Curti and Boldi (2021) have reported that the use of chatbots leads to increased student motivation. However, Ayedoun, Hayashi & Seta (2015) and Fryer, Nakao and Thompson (2019) have shown that while there may be an initial surge in student engagement, this tends to diminish over time, primarily due to the novelty effect inherent in this technology. One could argue that the level of engagement and perceived utility may vary based on the relevance that individual chatbots offer to students. The greater the perceived benefits of the chatbot, the higher the motivation for its use. With advancements in AI and machine learning, it is plausible that students will increasingly find relevance in chatbots, especially if these tools consistently provide accurate responses to their queries.

While App-integrated chatbots (AICs) demonstrate the capability to address a diverse range of queries, they often encounter challenges in navigating complex linguistic nuances, potentially leading to misunderstandings or improper language usage. Moreover, it has been noted that student interest may fade after the initial engagement period due to repetitive interactions characterized by established patterns and redundancies, resulting in interactions that feel less natural compared to real student-teacher experiences (Fryer, Nakao & Thompson, 2019). It can be argued that the more students engage with the chatbot and refine their conversational skills, the greater their motivation and sense of support in their learning journey.

Conceptualisation and design of the chatbot

The chatbot presented in this paper – UAboT - was developed using the software Melibo™, a software company based in Germany that offers a platform allowing users to develop AI chatbots without requiring advanced programming skills. Simply put, to produce a chatbot, the process involves several key steps, with careful planning being the cornerstone. The essential element is to design a scenario that encompasses a comprehensive array of potential questions and corresponding answers. The richness of the knowledge hub, which serves as a repository containing these questions and answers, directly influences the chatbot's conversational capabilities. Here is a breakdown of the typical steps involved in the creation of a chatbot:

1. **Planning the Scenario:** The first step involves outlining a scenario covering various topics or domains relevant to the chatbot's purpose. This scenario should encompass a wide range of potential questions that users might ask, along with corresponding answers.
2. **Building the Knowledge Base:** Next, a robust knowledge base needs to be developed, housing predefined questions and answers. This knowledge hub serves as the backbone of the chatbot's conversational ability. It should be populated with relevant information, ensuring comprehensive coverage of a diverse range of topics.
3. **Designing the Flowchart:** A flowchart must be created to illustrate the logic and decision-making process of the chatbot engine. This flowchart outlines how the chatbot analyzes incoming queries and determines the appropriate response based on the available information in the knowledge base.
4. **Analysing Queries:** When a user interacts with the chatbot by inputting a query or message, the chatbot engine employs natural language processing (NLP) techniques to analyze the text and understand the user's intent.

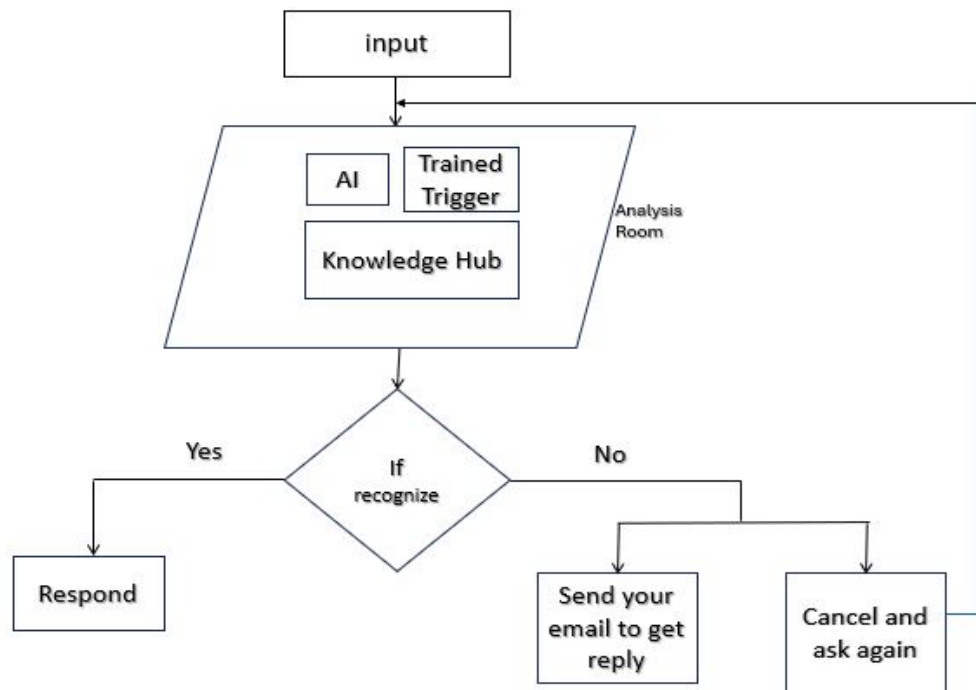
5. **Fetching a Response:** Using the information from the query analysis, the chatbot engine retrieves the most relevant response from the knowledge base. This response is selected based on factors such as semantic similarity, context, and relevance to the user's query.
6. **Generating a Conversation:** Once the response is fetched, the chatbot delivers it to the user, initiating a conversation. The chatbot continues this process iteratively, responding to subsequent queries and maintaining the flow of the conversation based on the user's input.

By following these steps and continually refining the knowledge base and conversational logic, developers can produce a chatbot that effectively engages users, addresses their inquiries, and provides valuable assistance. Figure 1 illustrates the flowchart depicting how the chatbot engine analyses queries and retrieves appropriate responses, serving as a visual guide to the chatbot's operation.

UAbot was developed to be used in a computer or a mobile device. The text console will appear when accessing the Moodle page for the programme. On the text console, the user has entered sentences which will be considered as input (Figure 1), those inputs can be generated by the user (through text with a query) or based on prompted questions (given by the chatbot to help users navigate through the information). The user interface controller drives the user request to analyse the component of text intention, entities, and context following machine learning approaches.

Figure 1

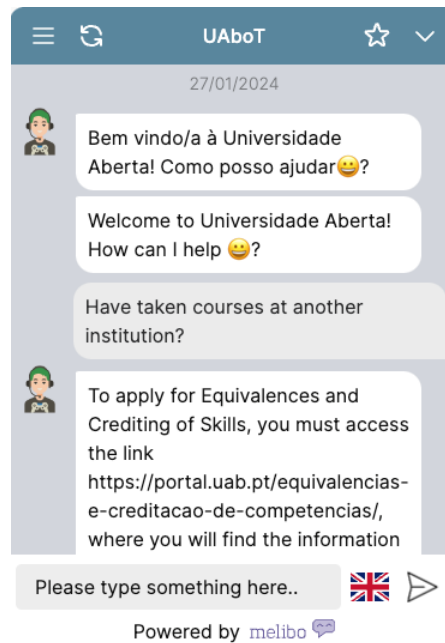
Flow chart depicting how a chatbot operates



The analysis room (figure 1) encompasses a pre-defined trigger, a knowledge hub, and artificial intelligence techniques. Not always necessary for the pre-defined trigger to match exactly the response available in the Knowledge Hub. The AI mechanism breaks down the text to work and recognises the sentence pattern (Chow, Sanders & Li; 2023). AI can boost a chatbot's performance, making it more potent than a traditional website and Google searches because the machine gains information from each interaction with the user and learns from their requests (Xu, Sanders & Chow; 2021). However, the system is also able to search the query from the knowledge hub. If the system recognises the sentence from all those elements, then it responds to the user with the correspondent answer (Figure 2). When the chatbot fails to recognise either the questions or the underlying patterns comprehensively enough to provide accurate responses, it can be programmed to redirect users to an email where they can contact a real person or access additional information. Users also have the option to resend their question if they are dissatisfied with the chatbot's response.

Figure 2

Image that represents a dialog between the student and UAbot



UAbot was introduced with the primary goal of reducing the dependency on frequent human support on the programme webpages of this Distance Learning University. Each programme offered by the university has dedicated webpages for both the programme team and students, serving as a central hub for inquiries regarding the programme experience. Students frequently turn to these pages for answers regarding assessments, registration, accreditation of prior learning, and university regulations. However, due to the repetitive nature of these inquiries and the large number of enrolled students (1242 in Engineering Informatics and 823 in Education), sustaining a consistent staff presence becomes challenging.

As part of the European HYBOT project - "Enhancing hybrid teaching in higher education through chatbots," the two programme teams embarked on developing a chatbot solution to swiftly address these frequently asked questions and provide continuous support to distance learners. In an era where Artificial Intelligence and chatbots, exemplified by tools like ChatGPT, have become increasingly prevalent in education, the programme teams sought to explore how students would adapt to finding answers through UAbot and gauge their perception of engagement with this innovative tool.

Methodology

The research is an exploratory quantitative and qualitative study using a questionnaire designed to elicit insights into students' initial perspectives on Chatbots, as well as their level of knowledge and confidence in using these tools. The questionnaire was constructed using Google Docs and distributed to students two weeks before the Chatbot became available on Moodle. It was administered anonymously and consisted of five closed-ended questions in the form of statements, employing a Likert scale, along with an open-ended question aimed at gathering students' perspectives on the strengths and limitations of chatbot use in education. Data analysis included descriptive statistics and thematic analysis (Clark & Braun, 2017).

The five statements asked to students were:

- Question 1 – I know what a virtual assistant is.
- Question 2 – I have already used a virtual assistant.
- Question 3 – I feel comfortable using a virtual assistant.
- Question 4 – I feel there is additional value in having a virtual assistant in the coordination and administrative support spaces of my course.
- Question 5 – In general, I trust the information provided by a virtual assistant.

Out of approximately 2,000 students invited to participate in this study, only 119 completed the questionnaire. The distribution among disciplines was as follows: 50.4% from Engineering Informatics, 48.7% from Education, and the remaining percentage from other fields. Regarding their year of enrollment, 30.3% were enrolled in year 1, 52.1% in year 2, and 17.6% in year 3. In terms of age, the most common age intervals were between 47 and 57 years (37.8%) and between 36 and 46 years (37.8%). The third highest age group comprised individuals aged between 25 and 35, constituting 18.8% of the respondents. The student demographics at this university primarily consists of adult learners, with an average age of 40 years.

In Engineering Informatics, the male-female gender ratio is 4:1, while in Education, is 1:4.

Following the deployment of UAboT, in January 2024, there will be a follow-up questionnaire to evaluate students' satisfaction levels with UAboT. This follow-up study will occur one month and six months after the UAboT's deployment.

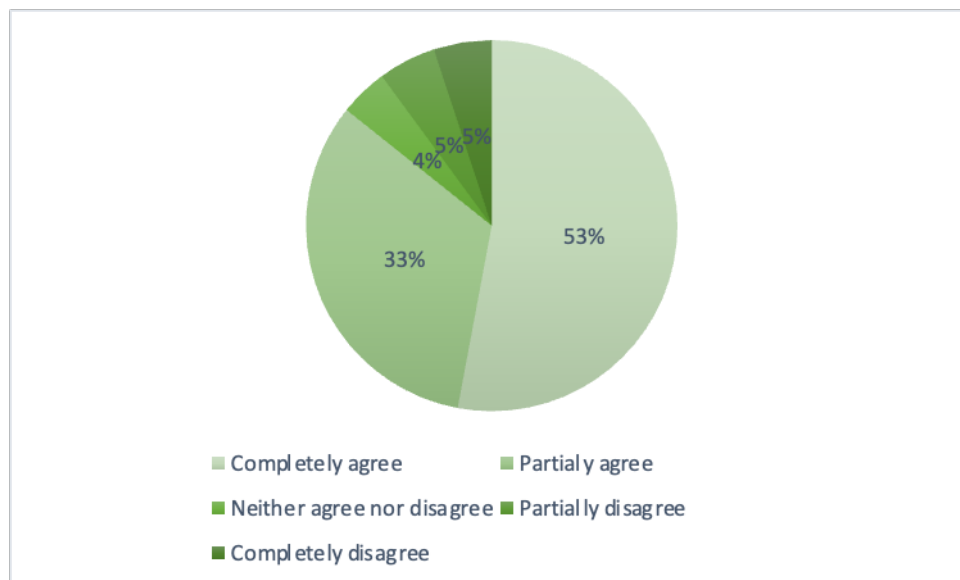
Data findings and discussion

Descriptive statistics

In relation to statement 1 - I know what a virtual assistant is (figure 3), 86% of students either completely agree or agree with the sentence. Only 10% of students don't agree with the statement which may suggest they have never heard about the name chatbot or at least they have not been able to cross reference it with ChatGPT or other similar virtual assistants.

Figure 3

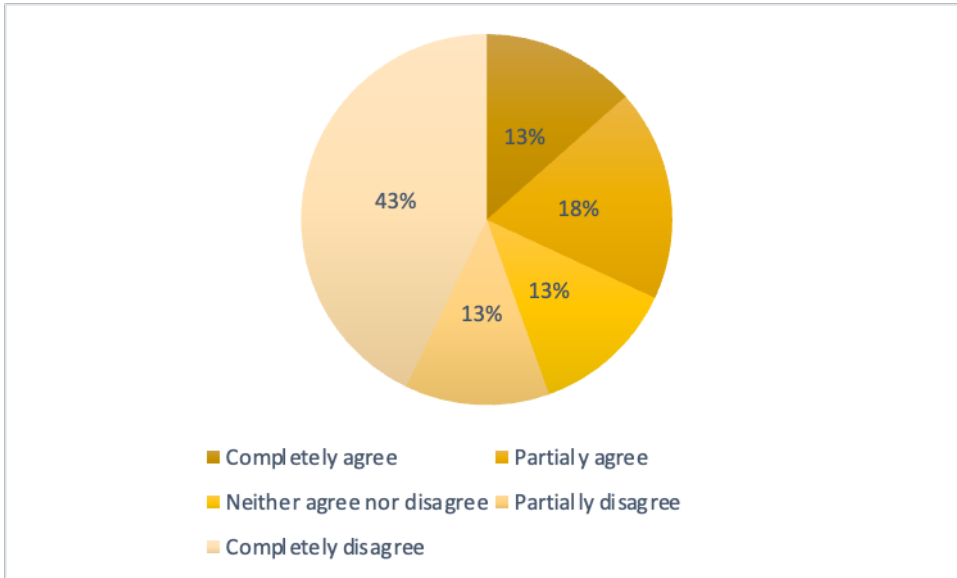
I know what a virtual assistant is.



In relation to statement 2- I have already used a virtual assistant (figure 4), we can infer that 56% of respondents do not agree with the statement which may suggest they have never used a virtual assistant.

Figure 4

I have already used virtual assistants.

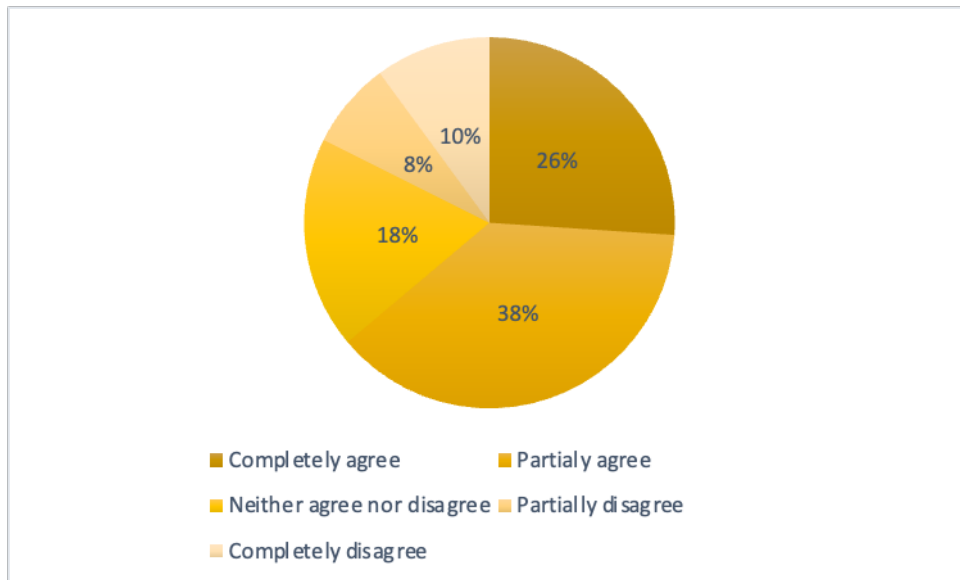


This finding is also surprising as Virtual Assistants have been made available in different services such as, for example, telecommunication websites or electricity providers websites as tools to support communication with clients. Similarly, one would assume that most students have trial tools such as ChatGPT, Alexa or Siri which, although different in nature from UAbot, share the same principles.

In relation to statement 3 - I feel comfortable using virtual assistants (figure 5) - 64% of participants have agreed with the statement which again may suggest they would feel comfortable using such tools to provide the answers they need. Only 18% do not agree with the statement, which is a small percentage when compared with the number of students that have not used a virtual assistant. This may suggest that although a significant percentage of students have not used a Virtual Assistant, they would feel comfortable and supporting of using such a tool.

Figure 5

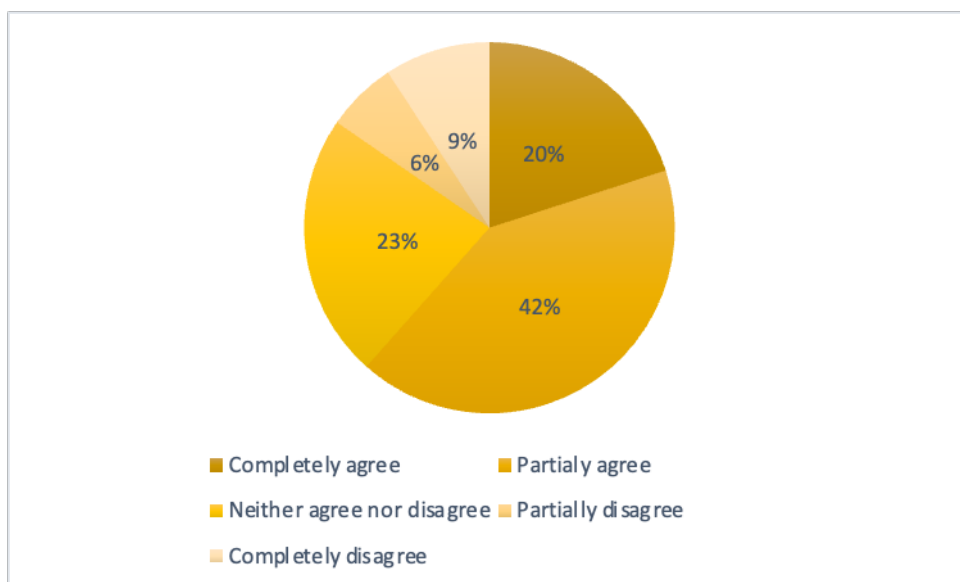
I feel comfortable using virtual assistants.



This assumption is supported by statement 4 - I feel there is additional value in having virtual assistants in the coordination and administrative support spaces of my course (figure 6).

Figure 6

I feel there is additional value in having a virtual assistant.



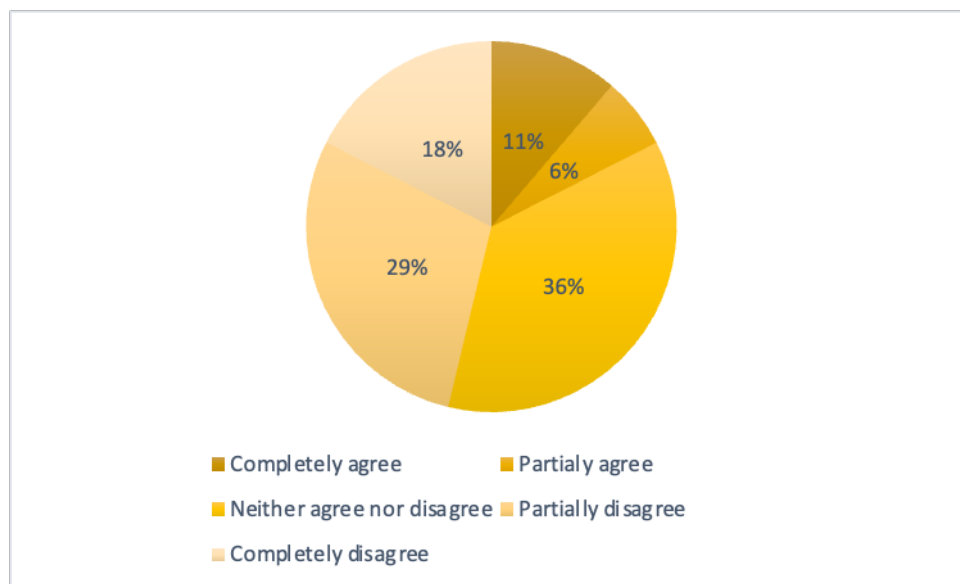
Whilst 62% agree with the statement supporting this initiative in principle, only 15% do not agree. This may imply that overall, there is broad support for using

chatbots in Course webpages to improve communication with students in both programmes.

Surprisingly, only 19% of students have agreed with statement 5 - In general, I trust the information provided by virtual assistants (figure 7), while 47% do not agree, and 36% neither agree or disagree.

Figure 7

In general, I trust the information provided by virtual assistants.



This likely stems from students' lack of exposure to the chatbot, which breeds scepticism about its effectiveness and accuracy. Nonetheless, this scepticism presents an opportunity to explore the world of chatbots and AI, possibly casting doubt on other widely used conversational tools such as ChatGPT or Microsoft Bing. It is certainly a topic worth reflecting on in terms of integrating generative AI into education.

Thematic analysis

Data analysis was also done to the open-ended question which aimed to understand the strengths and limitations of the use of chatbots in education. The themes that emerged were: (i) Support for Autonomous Study; (ii) Reliability of

Information; (iii) Flexible Scheduling; (iv) Impact on Learning and (v) Implementation and Use.

Support for Autonomous Study: the responses in this theme indicate that virtual assistants are valued for their ability to help fill gaps in the autonomous learning process. This suggests that virtual assistants are seen as useful tools to complement traditional study materials, such as manuals. Autonomous learning is a requirement for studying in higher education, a skill that allows students to become more self-motivated and more comfortable to engage in self-directed learning (Boud, 2012). With the growing demand for flexibility in learning processes, chatbots serve as an essential resource for students navigating through their educational material independently or to look for chatbots to respond to questions that may arise to students during their study time. Chatbots are programmed to provide instant, on-demand assistance, thereby complementing traditional communication channels or educational resources such as textbooks and lectures (Labadze, Grigolia & Machaidze, 2023). These virtual assistants offer interactive learning opportunities, adapt to individual student needs, and are accessible outside the conventional classroom setting, thus supporting the notion of anytime, anywhere learning.

Reliability of Information: This theme highlights concerns about the reliability of information provided by virtual assistants. Responses indicate a prevailing perception among users regarding the potential inaccuracies or unreliability of information sourced from these assistants. This perceived lack of reliability constitutes a significant concern that warrants careful consideration in the integration of such assistants within educational settings.

Flexible Scheduling: The responses emphasise flexible scheduling as a strong point of virtual assistants. By providing round-the-clock access to information and educational support, virtual assistants accommodate diverse learning preferences and lifestyles. This feature not only promotes convenience but also facilitates effective learning experiences, enabling students to engage with educational resources at their own pace and convenience, ultimately enhancing their academic success (Labadze, Grigolia & Machaidze, 2023).

Impact on Learning: This theme addresses the direct impact of virtual assistants on student learning. While some responses express reservations regarding the efficacy of these assistants in fostering effective learning experiences, others shed light on specific advantages. This nuanced perspective underscores the complexity of the relationship between virtual assistants and learning outcomes, indicating both potential benefits and challenges (Wambsganss, Janson & Leimeister, 2022; Winkler & Söllner, 2018). By exploring these diverse viewpoints, educators can gain valuable insights into the role of virtual assistants in enhancing student learning and tailor their implementation strategies accordingly to maximize their effectiveness.

Implementation and Use: Within this topic, the discussions revolve around the practical implementation and use of virtual assistants in education. This encompasses considerations such as how these assistants are incorporated into curricula, their user-friendliness, and their alignment with the requirements of both students and educators. The latter aspect arises from the fact that students have not yet had the opportunity to witness UAboT in action, making it challenging to grasp its value when employed.

Final considerations

In this study, we present preliminary findings regarding the integration of a chatbot into two distance education programmes. Our research indicates that while students are receptive to exploring the use of a chatbot to support learning, they harbor concerns about its effectiveness, accuracy, and overall impact. Since the UAboT has yet to be introduced to students, it is understandable that participants may still have reservations regarding the tool's value.

Despite these uncertainties, students expressed a belief that chatbots could prove beneficial in facilitating their autonomous learning and enhancing their interaction with university services or Course teams. Furthermore, they perceived the potential of chatbots to improve their engagement and alleviate feelings of isolation, which are occasionally experienced in distance education. Moving

forward, our study will proceed with the deployment of UAboT, followed by a subsequent evaluation of its impact on student experience. This follow-up investigation will prioritise aspects highlighted by students in response to open-ended questions, including: (i) Support for Autonomous Study; (ii) Reliability of Information; (iii) Flexible Scheduling; (iv) Impact on Learning as a strength and (v) Implementation and Use.

By addressing these key areas, we aim to gain a deeper understanding into the effectiveness and practicality of integrating chatbots into distance education programmes.

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