

Using Chatbots in Higher Education to Enhance the Student Experience

Background: Recent years has seen a rise in the use of AI Chatbots in higher education as institutions seek to use them as a tool to enhance the student learning experience [1]. Underlying factors driving the implementation of chatbots in education include improving administration and teaching efficiency; increasing student motivation; and engaging and widening the availability, personalisation and equitable access of education [2].

This N-TUTORR snapshot paper seeks to provide an overview and examples of the use of chatbots in higher education. Section 1 provides a short overview of chatbots in education, including definitions, classifications, design, usage and benefits. Section 2 describes several examples of chatbot use in Higher Education, including service-oriented and teaching-oriented chatbots. Section 3 lists questions that may be considered by practitioners in higher education seeking to create their own chatbot.

Section 1: Chatbot usage in higher education

What are chatbots?

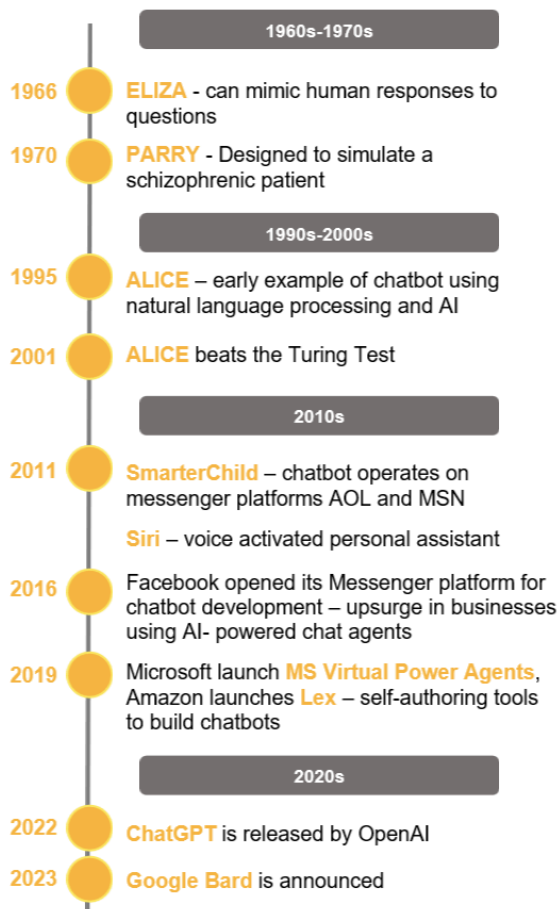
Chatbots have been defined as:

“...digital systems that can be interacted entirely through natural language via text or voice interfaces. They are intended to automate conversations by simulating a human conversation partner and can be integrated into software, such as online platforms, digital assistants, or be interfaced through messaging services.” [2]

- AI-powered chatbots use natural language processing to mimic human conversation and act as digital conversational agents to provide information to users [1], [3].
- They can help with a variety of tasks such as providing information on course content, structure and assessment criteria, study materials and campus locations [3].
- They can also engage students in more meaningful ways to facilitate self-study, such as facilitating practice questions and answers [3].



What is the brief history of chatbots?



Information compiled from [1]

How are chatbots classified?

- Chatbots can be classified as Service-oriented or Teaching-oriented [2]



Service-oriented: provide student services such as answering FAQs, acting as virtual assistants for admissions, or help students to navigate library systems



Teaching-oriented: Teaching-oriented chatbots act as digital tutors and are designed to help students learn their course material by generating information on specific course topics

- Overall, although service-oriented chatbots were the first to arrive on the educational scene, the usage of learning-oriented chatbots has rapidly increased in recent years, and now represent the most commonly used chatbot type in education [5]
- Teaching agent chatbots have been used to recommend tutorials to students, facilitate discussions on educational videos, prompt students to reflect on past learning, and to emulate a teacher conducting formative assessment by evaluating student's knowledge with multiple-choice questions [4]
- Interested readers are directed to a paper by Wollny et al. [2] which has an excellent conceptual map that visually represents the current landscape of chatbot use in education

What learning domains have chatbots been used for?

- There is strong usage of teaching chatbots to help students learn language [2], [4]
- Other identified learning domains include: programming, communication skills, educational technologies, cultural heritage, laws and mathematics [2], [4]

What are the benefits of chatbot implementation in education?

- Ability to easily integrate personalised content to students, facilitate quick access and responses, increase student motivation and engagement and allow multiple users [3]
- Improve student learning outcomes [2], [5]–[8]
- Enhance knowledge retention when used for learning [2], [8]
- Increase student motivation [3]
- Enhance student engagement [5]
- Enhance teacher effectiveness and efficiency [9]
- Statistically significant positive effect on learning performance, motivation, self-efficacy, interest and perceived value of learning [7]

How are chatbots designed and powered?

- Chatbots can differ greatly according to their underlying design, architecture and powering technology [5]
- There are 3 components that are common to all chatbot systems [5]: the graphic user interface (GUI), the chat backend (which usually involve the Natural Language Processor) and the database (Figure 1)

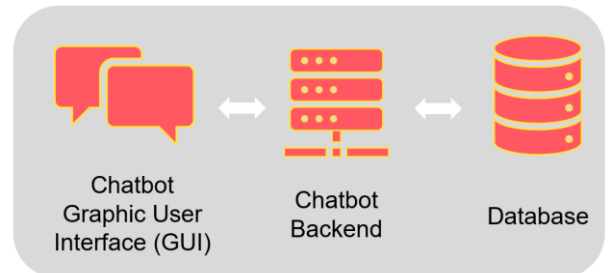


Figure 1. Three common components of all chatbot systems. Informed by [5]

- Chatbots can be either flow-based or powered by AI [4]
- Flow-based requires developers to design the potential scenarios that could be asked to the chatbot and provide sources to information. These conversations are typically chatbot-driven and are generally programmed with 'if-else rules'. This works well if the questions align with the provided work-flow and script, but can cause issues if not
- In AI-powered chatbots (like ChatGPT), the chat backend uses artificial intelligence and Natural Language Processing (NLP) to identify the questions being asked and pull up the correct information [5], [10]. The NLP engine allows the chatbot to be able to make sense of the user input (i.e., the message sent by the student into the chatbot) and provide an answer. In this way, artificial intelligence can be used to "...analyse user entries, learn from them and generate a response as appropriate as possible to the input entered" [10]
- For a detailed description of the technical architecture of chatbots, see [10]

Can I build my own chatbot?

In short, yes! There are several organisations that provide subscriptions to self-authoring tools that can be used to create chatbots:

- MS Power Co-Pilot (previously known as MS Power Virtual Agents)
- Amazon Lex
- Pubble Chatify

Section 3 has some practical questions to consider before embarking on building your own chatbot.



Section 2: Examples of successful chatbot use in higher education

This section describes several examples of successful use of chatbots in higher education. Examples have been classified as being either service-oriented or teaching-oriented.

Examples of service-oriented chatbots



DINA at University of Indonesia

Dinus Intelligent Assistant (DINA), used in Universitas Dian Nuswantoro in Indonesia, is a chatbot that was designed to act as a conversation agent to help students in the role of student candidate service [11].

The primary way that DINA is used is to answer questions in the field of education to prospective university students. To answer the questions, DINA uses a database that is informed by the Universitas Dian Nuswantoro guest book. Search queries are fulfilled through keywords, phrases and specific examples.

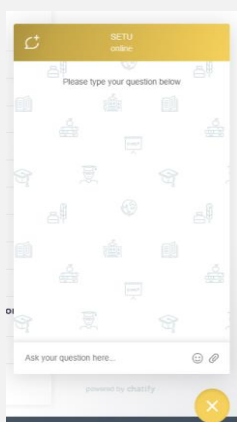


Pubble at SETU (Waterford IT), Ireland

According to their [customer success stories](#), SETU (Waterford IT) piloted two of Pubble products, Live Q&A and Chatify, in 2015. SETU first tried out Pubble's live Q&A feature at one of their CAO events for prospective students. However, since this trial, they have had more students use the Chatify feature. Chatify is an AI chatbot that uses Natural Language Unit processing to answer student questions via an instant messaging platform, the 'chatbot'.

SETU use Chatify throughout the year for their undergraduate course section of their website. To give an idea of user volume, in 2018 they processed 6,000 conversations through Chatify.

Their Webmaster, Brian Hackett, specifies the 'auto-answer' bot as his favourite feature. This feature provides instant answers to frequently asked questions which "eases the burden on the exams office who get flooded with queries around results day".



Genie at Deakin University, Australia

Genie is a virtual assistant app for students at Deakin University in Australia, that is designed to help with a variety of aspects related to student life, including answering questions, scheduling and creating reminders [16], [17].

The virtual assistant uses NLP to create natural sounding conversations [18]. In 2018, more than 25,000 students had downloaded the app [16]. According to Deakin University's chief digital officer, William Confalonieri, during peak times students can initiate up to 12,000 conversations a day with the Genie app [16]. This is similar to the volume of calls that used to be experienced by the student association helpline [16], highlighting the potential virtual assistants hold to decrease administrative burden on staff. Unlike most FAQ type chatbots, the Genie virtual assistant is tailored to each student, and provides specific information accordingly.



Watch this promotional YouTube about the Genie app: [\(147\) Deakin Genie - YouTube](#)

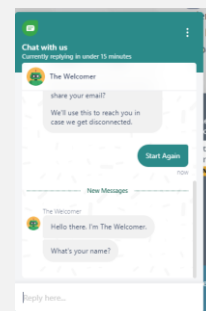
Ada at Bolton College, U.K.

Ada at Bolton college (a further education college) in the UK is a chatbot that was designed to ease administrative staff workload [12]. Launched in April 2017, the Ada was designed using Amazon Sumerian, which is a self-authoring tool use to create chatbots. Ada is an example of a service-oriented chatbot and acts as a campus digital assistant. For example, Ada can effectively answer questions like 'What is my timetable' or 'When is my next exam?'. In addition, Ada also supports administrative tasks, such as providing students for their grades on GCSE results day.

Beacon at Staffordshire university, U.K.

Beacon is a service-oriented chatbot used at Staffordshire University, UK [13]. It was built by cloud service providers ANS using MS Azure Stack [13]. Beacon helps with administrative tasks, such as issuing new ID cards, helping students to find lecture halls, and answering FAQs [13].

It's built as a smartphone app, and also acts as a digital coach for students, which they hope will reduce drop out [19]. It's the first digital assistant app launched in a university in the UK [19].



Section 2: Examples of successful chatbot use in higher education (cont.)

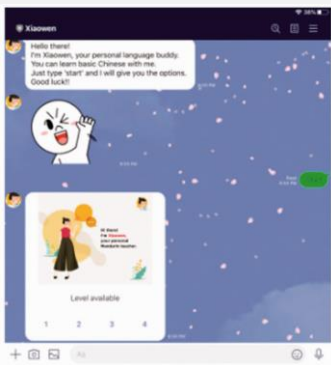
Examples of teaching-oriented chatbots



Learning Chinese with Xiaowen

Xiaowen is a messaging chatbot that was designed to help university students at Taiwan University to learn new Chinese vocabulary [6]. The Chatbot was developed via python programming and the 'LINE' developer platform. Students add Xiaowen to their friend list on 'LINE'.

Once added, the chatbot initiates a conversation, inviting students to 'start' by entering the text 'start' as a message. Once activated, the chatbot shows four levels, between 1 to 4, that students can use to determine the level of the lesson. Then students are asked whether they want to activate learning mode or practice mode. Upon choosing learning mode, the chatbot presents a series of new Chinese vocabulary to learn. Upon choosing practice mode, the chatbot acts as an instructor and presents a series of questions based on the vocabulary list.



The chatbot can provide feedback based on the student answer: on a correct answer the chatbot denotes it as correct and moves on to the next questions; on an incorrect answer the chatbot denotes it as incorrect and provides the correct answer [6]. A quasi-experimental investigation involving pre-tests and post-tests indicated that after using the Xiaowen chatbot, in both one-on-one and one-on-classroom contexts, for four weeks statistically significantly increased students' learning of Chinese vocabulary [6].



EconBot, Spain

EconBot was designed by a team teaching economics in a distance learning university in Spain [14]. The chatbot was designed using an undisclosed commercially available free version of platform for creating and deploying conversational robots. EconBot was designed with two purposes in mind:

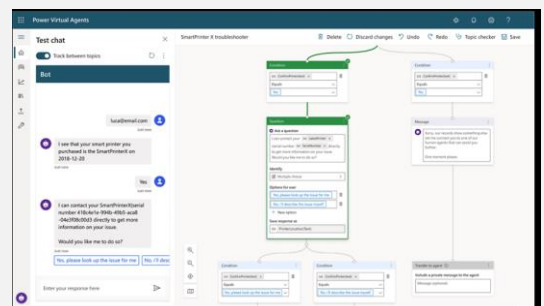
1. Help students review economics material (teaching-oriented): receive message of support and reminders to complete assignments, review content through multiple choice questions, messages with explanatory content, reminders of important concepts, and links to digital content that had been identified by the teaching team as being useful for that subject
2. Provide information on a range of administrative issues such as ways to contact the teaching team, office hours, exam dates etc. (service-oriented)

DigiHelp, MIC, Limerick

DigiHelp is a chatbot that was used to assist undergraduate students undertaking a digital competencies module as part of their Bachelors in Arts at Mary Immaculate College, Limerick [15]. The chatbot was created using the Microsoft Power Virtual Agents for MS Teams, which students could add to their MS teams chat space.

As part of their assignment, students were instructed to ask the chatbot at least one question each week to help them upskill in digital competencies. In this way, the chatbot could be categorised as teaching-oriented, as its primary aim was to aid learning. In addition to answering questions, the chatbot also provided notifications. In the design of the chatbot, the DBR capstone phase featured 600 students accessing the chatbot.

In their PhD thesis that more fully describes their work, [20] notes that they created the chatbot using trigger phrases and conversation nodes. As part of the design process, it was estimated which trigger phrases students may input, and then an associated conversation.



Section 3: Guiding questions to consider when designing a chatbot

There are several aspects which should guide chatbot design and development, such as usability principles, chatbot personality, chatbot localisation and acceptance, development framework, and end-user development [4]. In addition, AI is a fast-evolving technology, and readers are encouraged to keep up to date with emerging EU legislation for best practice e.g., the European Commission AI act [21].

Before embarking on creating a chatbot for use in higher education, consider answering the following design questions:



What do you want the chatbot to achieve?

What is the desired outcome of implementing this chatbot in your educational environment? Examples include:

- Reduce administrative tasks for staff
- Reduce risk of new student drop-out
- Achieve specific learning outcomes
- Improve campus culture



Will the chatbot be service- or teaching-oriented?

- If service-oriented, which services will the chatbot provide e.g. FAQs or administrative assistance, or both?
- If teaching-oriented, which subject will the chatbot support? Will the chatbot act as a teaching agent, peer agent, teachable agent or motivational agent?



Who will the chatbot be for?

- Will the chatbot be for all students or a specific cohort?
- Will users need specific training in using the chatbot?
- How many users are anticipated to use the service?
- How often is it anticipated users will use the service?



Where will the information come from?

- What will be the information source?
- Do you have ownership of this information source? Is it reliable and trustworthy?
- Is it up to date? How often is it updated?
- Where is it hosted? Depending on how the chatbot is built, it may be restricted e.g., Microsoft Co-pilot cannot use a URL source that is more than two levels deep.



How will the chatbot be built?

This will help you decide whether you will be able to build the chatbot using a commercially available service such as Amazon Lexa, Microsoft Co-Pilot or Pubble Chatify. You may consider the following factors:



Purpose and complexity of the chatbot:

A service-oriented chatbots designed to answer simple FAQs could be achieved using a simple commercially available option such as Chatify. A more complicated chatbot which needs to be integrated into a mobile app and act as a digital assistant (like Genie or Beacon) may need a specific IT solutions provider.



Maintenance: A more complex system will require regular updates and maintenance – this will be limited by available resources and budget.



Facilitation: Will it need the capacity to escalate to live agents? Who are these live agents? Who will oversee management, training, scheduling? Who will moderate the backend?



Available expertise: If you decide to use a self-authoring build (e.g. Amazon Lexa), who will build it? Does the necessary expertise and experience exist in-house? Is there training available?



Data analytics: What data analytics do you need the chatbot to generate? Can we track number of requests, inputted information, number of resolved/escalated requests, user data etc?



Integration ability: Can the provided architecture be integrated into VLEs? Is this required?

References

- [1] L. Labadze, M. Grigolia, and L. Machaidze, "Role of AI chatbots in education: systematic literature review," International Journal of Educational Technology in Higher Education, vol. 20, no. 1. Springer Science and Business Media Deutschland GmbH, Dec. 01, 2023. doi: 10.1186/s41239-023-00426-1.
- [2] S. Wolny, J. Schneider, D. Di Mitri, J. Weidlich, M. Rittberger, and H. Drachsler, "Are We There Yet? - A Systematic Literature Review on Chatbots in Education," Frontiers in Artificial Intelligence, vol. 4. Frontiers Media S.A., Jul. 15, 2021. doi: 10.3389/frai.2021.654924.
- [3] C. W. Okonkwo and A. Ade-Ibikola, "Chatbots applications in education : A systematic review," Computers and Education: Artificial Intelligence, vol. 2, pp. 1–10, 2021.
- [4] M. A. Kuhail, N. Alturki, S. Alramlawi, and K. Alhejori, "Interacting with educational chatbots: A systematic review," Educ Inf Technol (Dordr), vol. 28, no. 1, pp. 973–1018, Jan. 2023, doi: 10.1007/s10639-022-11177-3.
- [5] J. Q. Pérez, T. Daradoumis, and J. M. M. Puig, "Rediscovering the use of chatbots in education: A systematic literature review," Computer Applications in Engineering Education, vol. 28, no. 6. John Wiley and Sons Inc, pp. 1549–1565, Nov. 01, 2020. doi: 10.1002/cae.22326.
- [6] H. L. Chen, G. Vicki Widarso, and H. Sutrisno, "A ChatBot for Learning Chinese: Learning Achievement and Technology Acceptance," Journal of Educational Computing Research, vol. 58, no. 6, pp. 1161–1189, Oct. 2020, doi: 10.1177/0735633120929622.
- [7] R. Wu and Z. Yu, "Do AI chatbots improve students learning outcomes?," British Journal of Educational Technology, May 2023, doi: 10.1111/bjet.13334.
- [8] X. Deng and Z. Yu, "A Meta-Analysis and Systematic Review of the Effect of Chatbot Technology Use in Sustainable Education," Sustainability (Switzerland), vol. 15, no. 4. MDPI, Feb. 01, 2023. doi: 10.3390/su15042940.
- [9] L. Chen, P. Chen, and Z. Lin, "Artificial Intelligence in Education: A Review," IEEE Access, vol. 8, pp. 75264–75278, 2020, doi: 10.1109/ACCESS.2020.2988510.
- [10] K. Maria, A. Drigas, and C. Skianis, "Chatbots as Cognitive, Educational, Advisory & Coaching Systems," pp. 109–126, 2022, [Online]. Available: www.techniumscience.com
- [11] H. A. Santoso et al., "Dinus Intelligent Assistance (DINA) Chatbot for University Admission Services," 2018.
- [12] JISC, "National centre for AI in tertiary education launches chatbot pilot," Jisc News. Accessed: Jun. 12, 2023. [Online]. Available: <https://www.jisc.ac.uk/news/national-centre-for-ai-in-tertiary-education-launches-chatbot-pilot-14-dec-2021>
- [13] Times Higher Education, "Developing a digital strategy for student support with AI chatbot," Times Higher Education. Accessed: Jun. 12, 2023. [Online]. Available: <https://www.timeshighereducation.com/hub/p/developing-digital-strategy-student-support-ai-chatbot>
- [14] P. A. Tamayo, A. Herrero, J. Martín, C. Navarro, and J. M. Tránchez, "Design of a chatbot as a distance learning assistant," Open Praxis, vol. 12, no. 1, p. 145, Mar. 2019, doi: 10.5944/openpraxis.12.1.1063.
- [15] N. Armstrong, "Investigating digital agility: Using a chatbot to scaffold learning opportunities for students," in European Learning and Teaching Forum, Feb. 2023. Accessed: Jun. 07, 2023. [Online]. Available: https://eua.eu/images/site1/events/2023/LT_presentations/Practicepresentation-Niamh_Armstrong.pdf
- [16] Glen Atwell, "Deakin's Genie: a virtual digital assistant out of the bottle," Deakin University media release.
- [17] G. Garcia Brustenga, M. Fuertes-Alpiste, and N. Molas-Castells, "Briefing paper: chatbots in education," Barcelona, 2018. doi: <https://doi.org/10.7238/elc.chatbots.2018>.
- [18] William Confalonieri, "Deakin Genie: Youtube Video," YouTube.
- [19] Microsoft, "Staffordshire University to launch first digital assistant for students," Microsoft News. Accessed: Jun. 12, 2023. [Online]. Available: <https://news.microsoft.com/en-gb/2019/01/30/staffordshire-university-to-launch-first-digital-assistant-for-students/>
- [20] N. Armstrong, "Investigating digital agility: Using a chatbot to scaffold learning opportunities for students," Lancaster University, Lancaster, 2022. Accessed: Jun. 07, 2023. [Online]. Available: <https://eprints.lancs.ac.uk/id/eprint/180862/1/2022ArmstrongPhD.pdf>
- [21] European Commission. (2023) AI Act. Available at: <https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai#:~:text=The%20AI%20act%20allows%20the,EU%20fall%20into%20this%20category.>

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This snapshot paper is designed for discussion and intended to serve as a foundation for dialogue and collaboration. We welcome and value feedback and suggestions in shaping the evolution of the concepts and ideas presented here.

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