

Manuscript version: Author's Accepted Manuscript

The version presented in WRAP is the author's accepted manuscript and may differ from the published version or Version of Record.

Persistent WRAP URL:

<http://wrap.warwick.ac.uk/164866>

How to cite:

Please refer to published version for the most recent bibliographic citation information.

Copyright and reuse:

The Warwick Research Archive Portal (WRAP) makes this work by researchers of the University of Warwick available open access under the following conditions.

Copyright © and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable the material made available in WRAP has been checked for eligibility before being made available.

Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge. Provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.

Publisher's statement:

Please refer to the repository item page, publisher's statement section, for further information.

For more information, please contact the WRAP Team at: wrap@warwick.ac.uk.

AI Chatbot for Educational Service Improvement in the Post-Pandemic Era: A Case Study Prototype for Supporting Digital Reading List

Shanshan Yang

Warwick Manufacturing Group, University of Warwick, Coventry, UK, S.Yang.6@warwick.ac.uk

Kim Stansfield

CENG, MIET, MINCOSE, Retired (Dec 2020) Associate Prof., Warwick Manufacturing Group, University of Warwick, Coventry, UK, Kimestansfield@gmail.com

This paper describes the development of an educational artificial intelligence (AI) chatbot prototype to support teachers in developing digital reading lists for their students. The chatbot aims to teach users how to use an educational system – Talis Aspire – effectively by giving them quick answers to questions, offering demonstrations and instructions on how to complete essential tasks on Talis Aspire, advising them how to solve problems and providing solutions for common issues. We have presented the prototype, together with the approach we used to design and develop it by considering the concepts of ‘Recontextualisation’ and ‘Quality Function Deployment’. We argue that the use of chatbot technology can not only help tutors develop online education and teaching materials but may also improve the quality of educational services during and after the COVID-19 pandemic. A number of recommendations and further work suggested by domain experts have also been highlighted in this paper in order to improve our prototype further.

CCS CONCEPTS • Applied computing • Education • Computer-managed instruction

Additional Keywords and Phrases: AI Chatbot, AI in Education, Educational Service Improvement, Quality Function Deployment (QFD), Talis Aspire, Post-Pandemic

1 Introduction

The COVID-19 pandemic has affected everyone across the world; it has changed the way we live, the way we work and the way we teach and learn. In the educational domain, it has become crucial to carefully listen to the voice of our staff and students and effectively respond to their changing needs and expectations. Chatbot technology has the potential to capture and prioritise our students’ and our staff’s changing needs.

In this paper, we have conducted a case study and developed an AI chatbot prototype to support teachers and students to develop digital reading lists via Talis Aspire. Based on the digital lists developed, students can then access the reading resources available in the library and on the Internet efficiently. The principles of Quality Function Deployment have been applied in focusing on capturing the key stakeholder needs and understanding whether the technology can be aligned to satisfy these needs.

2 LITERATURE REVIEW

2.1 Theoretical Considerations: Recontextualisation and Quality Function Deployment

Recontextualisation is a process that extracts knowledge from its original context and reuses it in another context to bring added value to it [1, 2]. In the education domain, this means that knowledge can be extracted from

traditional contexts, such as textbooks and classrooms, to other digital contexts, such as web pages, instructional videos and blogs [3]. In this paper, a case study is presented. An AI chatbot is used as a new knowledge communication medium to communicate technical knowledge within the Talis system to develop digital reading lists from the perspective of recontextualisation. The key stakeholders that were identified for this phase of the evaluation were teaching staff, teaching support staff and students.

There are limitations to teaching people how to use educational applications effectively in traditional contexts (through textbooks and in classrooms), especially when users are under pressure and only have a limited amount of time. As in most cases, technical knowledge is represented by texts and diagrams. Learners might not be able to understand the concepts easily and may not be able to apply them in practice quickly. They may become bored easily because of the language, text fronts and colors used, or they may be exposed to a large amount of irrelevant information. Additionally, there are fewer interactions available during the knowledge communication process. The learning must take place within a fixed timeframe or at a fixed location – users cannot take control of their own learnings flexibly. The tutors and learning support team may not be able to respond to the enquires quickly enough if the learners are based in different time zones, especially during the Pandemic. AI chatbots have the potential to improve upon these limitations.

The AI chatbot, as a new knowledge communication media, has the potential to teach students and teachers in a way that is more interesting, engaging and flexible than traditional teaching methods [4]. A chatbot encourages them to take more control of their own learning. It aims to filter out unnecessary and irrelevant information to help users complete specific tasks. It also promotes communication and interactions between users and the university systems. The use of multimedia in the chatbot has the potential to help users engage with the content more effectively [5]. The other potential benefits will be discussed in later sections.

In a previous study to assess the potential for Virtual and Mixed Reality (VR and MR) to help enhance student engagement in engineering degree courses, a similar approach was taken where the modern Quality Function Deployment (QFD) methods were used to help capture, structure and prioritise needs and evaluate the alternative VR and MR technologies against these needs [6].

2.2 AI Chatbot for Learning and Teaching

A few recent studies have been conducted to develop chatbots for learning and teaching. Vanichvasin [7] implemented a chatbot to help students develop their research knowledge. Makhkamova's team [8] proposed the idea of multi-chatbots for online teaching. Gonda and Chu [9] highlighted a chatbot's potential roles in the pre-module, in-module and post-module stages. Neto and Fernandes [10] developed a bot to support online collaborative learning.

However, none of the chatbot studies have addressed technology in terms of quality improvement and quality function deployment (QFD) aspects, and none of them have created a chatbot to support the development of digital reading lists.

3 The Reading list chatbot prototype

The reading list chatbot prototype aims to give quick answers to questions, offer demos and instructions on how to complete certain tasks on the Talis system, help to solve problems and provide details about issues. Students can then access the reading resources available in the library based on the digital lists developed. These lists are very useful, especially when teachers and students are working remotely. The AI chatbot supports the following main features.

3.1 Explains to users what they need to do when updating their lists (see [Figure 1](#))

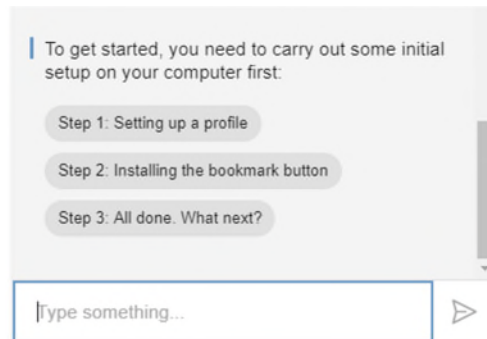


Figure 1: What to do next

3.2 Provides demos and instructions regarding how to find, edit and publish reading lists (see [Figure 2](#))

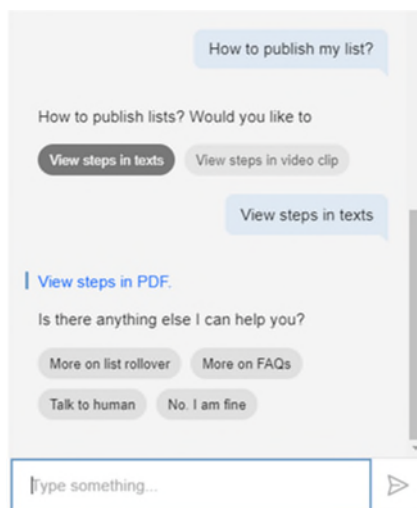


Figure 2: How to publish the list

3.3 Offers advice to users regarding how to solve problems and get further human help if users cannot resolve the issues by themselves (see [Figure 3](#))

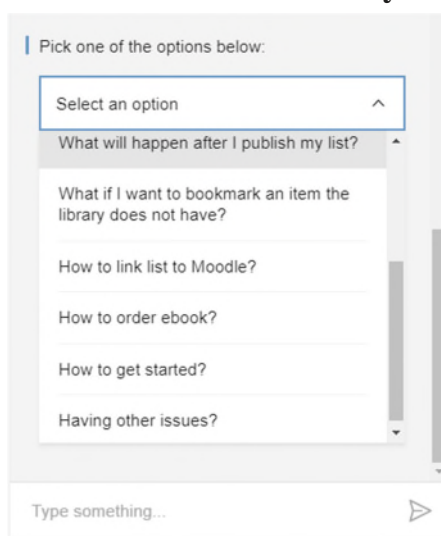


Figure 3: Troubleshooting FAQs

4 Processes to develop the chatbot

The reading list chatbot prototype aims to give quick answers to questions, offer demos and instructions on how to complete certain tasks on the Talis system, help to solve problems and provide details about issues. Students can then access the reading resources available in the library based on the digital lists developed. These lists are very useful, especially when teachers and students are working remotely. The AI chatbot supports the following main features.

4.1 Understanding Chatbot Technology

Chatbots normally consist of three main components: intents, entities and blocks. The actual names may vary in different bot development frameworks. Intents are what a user wishes to achieve in a conversation; entities are variables like names, numbers and locations, which help the bot to filter answers; and blocks are sections that group a number of intents and entities together by a particular topic in the dialogue.

Different bot development frameworks have their own strengths and weaknesses. They can be integrated into websites, software applications, messages and social networks. It is important to choose the most suitable bot development platform during the early stages. We have chosen a bot development platform based on the fact that its chatbot can be easily integrated into universities' existing educational systems.

4.2 Getting to Know the Users

We have been helping teachers and students to use the reading list over the past five years and have gained some insight into their needs. For example, we have found out what their pain points are and what questions, problems and tasks they frequently have. However, their needs will always change over time; we cannot capture them all effectively.

4.3 Creating dialog flows

Making the chatbot user/stakeholder-centered is one of the design principles we have considered using the Modern QFD framework described in the ISO 16355 standard parts 1 and 2 [11, 12]. We have applied a number of use cases that address the common tasks that teachers frequently perform, e.g. finding the lists, editing the lists and publishing the lists. We have also included use cases for beginners and experienced users (see Figure 4) FAQs are also considered. The chatbot provides details about issues and offers demos and instructions that tell users how to resolve common problems encountered when updating their lists.

To start with, sticky notes are a useful tool to develop the dialogue flows. We can move and rearrange the flows easily and endlessly on a wall or a whiteboard. There are also commercial software, such as BotMock [13], that allow team members to develop/refine the dialogue flows collaboratively and remotely.

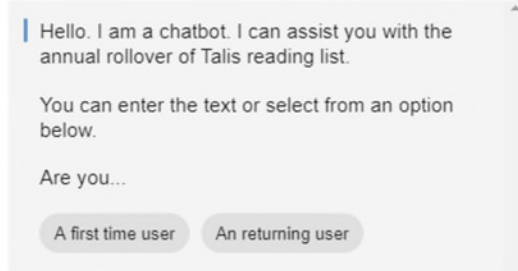


Figure 4: Different type of users

4.4 Developing Dialogues Contents

Depending on the nature of the answers, we classified the chatbot responses into the followings (see Table 1):

- Short answers from the chatbot
- Long answers/instructions on webpages or in PDF files.
- Instructional video demos on the media hosting server

Table 1: List of some dialogue contents

Intents	Sample Query	Type of response	Location to host the response
#create_new_list	How to create a new list	Short answer	Bot platform
#bookmark_item	How to bookmark an article	Video demo and long instructions in texts	Media server and web pages
#get_further_help	How to get further help	Short answer	Bot platform
#reading_importance	How to change reading importance	Video demo and long instructions in texts	Media server and web pages
#install_bookmark	How to install bookmark button - Safari	Video demo and long instructions in texts	Media server and web pages
#cannot_find_list	Still cannot find my list	Long instructions in texts	Web pages
#cannot_open_link	Still cannot open my list	Video demo and long instructions in texts	Media server and web pages
#item_not_in_library	Still cannot find my item from the library	Video demo	Media server
#review_button	What will happen the list is published	Short answers	Bot platform

The table above lists some of the questions that the reading list bot can answer, as well as how and where the responses are hosted. We have reused most of the currently available resources developed by the educational institution. We have also developed some extra video demos and step-by-step instructions for chatbot users.

5 Technology Evaluation

The reading list chatbot prototype aims to give quick answers to questions, offer demos and instructions on how to complete certain tasks on the Talis system, help to solve problems and provide details about issues. Students can then access the reading resources available in the library based on the digital lists developed. These lists are very useful, especially when teachers and students are working remotely. The AI chatbot supports the following main features.

5.1 Involving Humans in Interactions and Integrating Them into Existing Systems

The chatbot can give quick answers to questions, provide details about issues and help solve problems. However, at times, the chatbot will reach its limit. Ideally, human helpers from the support team should get involved. Some bot development frameworks do have such a feature; however, the communication channels they can support are limited. Some only support live chat in Facebook messenger or Intercom email service; thus, it is not straightforward to integrate into a university's current system. Currently, the queries that are not answered by the chatbot are answered by a human via email.

5.2 Usage Analysis and Service Quality Improvement

Some chatbot development frameworks also have a built-in usage analytics feature. This may report the number of conversations that occurred over a period of time, the number of top intents (see [Figure 5](#)). This feature is very useful for understanding customer requirements and the usage of the chatbot. However, the user requirements analytics are still limited. We cannot export the usage data, we cannot customize the analysis approach and we cannot distinguish/prioritise the importance of each requirement, i.e. determining which are necessary and which are not. We cannot measure customer satisfaction level, i.e. how many users are happy and with what or how many users are unhappy and with what. These measurement and indications are very useful in helping us understand the quality of educational services we have provided. These findings also have the potential to help us to identify areas of improvement regarding currently used e-educational systems.

Top Intents:	Total
#publish_list	59
#create_new_list	21
#cannon_open_list	11
#get_further_help	5
#item_not_in_library	2
#cannon_find_list	0

Figure 5: Top requirement analysis

6 DISCUSSION WITH EXPERTS

We have discussed this prototype with industry partners and IT experts as well as educational specialists and have has several recommendations made for future work. These will be looked at in the following sub-sections.

6.1 Service improvements

The Talis Aspire reading list system is only one of the many educational applications commonly used in the UK. Due to the COVID-19 pandemic, more and more universities are moving their teaching online and, therefore, more educational systems are being introduced to support this than ever before; for example, MS Teams and Zoom are being used to support online lectures and seminars, and alternative assessment systems have been employed to support online examinations and assignments. Developing teachers', students' and university staff's digital capability has become more important. However, training and supporting teachers and students to make use of these new systems is a large task for most educational institutions. AI chatbot technology has the potential to take over some responsibilities, thus reducing staff workload and associated stress. It also has the potential to support the use of newly introduced popular educational systems other than Talis Aspire. Such technology can improve the quality of educational services by:

- Helping tutors to deliver online education or develop teaching materials.
- Helping to capture and prioritise teachers' and students' changing needs when using educational systems.
- Helping users of new educational applications identify where they can be improved.
- Promoting active and autonomous learning in an online environment.
- Promoting user-centred one-to-one interactions and consultations.
- Providing flexible 24/7 online support across multiple time zones.
- Promoting personalised learning pathways.
- Reducing teachers' and support staff's workloads and reducing costs.

6.2 AR and AI

One aspect of our future work will include integrating the AI chatbot into our augmented reality (AR) learning environment in order to create richer and more comprehensive experiences for our learners and explore innovative teaching methods for our users. However, there are still several design and technical challenges to explore and overcome. This would include extending the QFD study on use of AR/ VR to engineering education, courses [6] to refine the Customer Voice Table, shown in [Figure 6](#) below, to add specific needs for the Chatbot users as well as the AR/VR users.

Customer / Stakeholder Voice				
Customer/ Stakeholder segment	Characteristics	Situations	Problems	Customer - Stakeholder Needs
Lecturer for PT UG Apprentice degree	Lecturing UG Part time engineering apprentices - diverse roles	1. Designing & Developing/ Upgrading Lectures	Little time to identify where to improve lectures or adopt new ideas.	Able to upgrade/ create lecture materials quickly
	Students: varied backgrounds, studying 1 week at a time - 6 weeks/ year	2. Delivering Lectures	Communicating complex engineering or mathematical concepts in limited time	Lectures that explain complex concepts & relationships in memorable way
Part Time Apprentice UG Degree Student	Short of time- supports UG & PG Lecturing and Examinations	Attending intense, week long blocks at University	Material static - doesn't allow student to investigate concepts	Lecture material allows student to investigate complex concepts
	New to higher education - education/ experience to 8th form level		How to communicate/ understand work and role context for concepts being taught	Relevance of concepts to work and role context made obvious to students
	Working in functional department within sponsoring organisation		Absorbing & understanding many complex engineering or mathematical concepts in limited time	To maintain energy and enthusiasm through multiple discipline lectures
				Material allows student with different learning styles to use their preferred style

Figure 6: Customer / Stakeholder Voice Table for AR/VR Usage [6]

6.3 Learning accessibility and inclusion

Accessibility has become more and more important in recent times. 'Being inclusive is about giving equal access and opportunities to everyone wherever possible' [14]. Chatbot's built-in voice feature has the potential to support disabled users by improving accessibility and interaction, particularly by providing support for those users with reading or writing difficulties.

6.4 User experiences

Learning design is one of the key factors in creating a good learning experience. When we developed the chatbot, we were not only thinking about what a user does at each step but also considering what they are thinking and feeling. Another avenue for future work is evaluating this chatbot further by exploring what emotions have been generated while users are interacting with it.

6.5 Adapt to changes

The Talis Aspire system has been updated regularly every year, adding new features and improving the user interfaces (UI) over time. The AI chatbot, which supports the use of the Talis Aspire system, has to be updated regularly to mirror these improvements. This includes the videos and instructions, which need to be changed frequently. This places an additional workload on the maintenance and support teams. It should be noted that training people to maintain the chatbot and subscribing to the chatbot hosting platform costs money. It is worth considering the balance of costs and benefits for this as an investment, as well as making sure to choose the most appropriate educational applications and chatbot technology from which to obtain the most value.

7 Conclusions

This paper has proposed the prototype of an AI chatbot to support users in developing and making use of digital reading lists in educational institutions. The potential educational, technical and management stakeholder benefits have been highlighted and discussed throughout the paper. It is recommended that the further use of

modern QFD methods can help achieve an even greater alignment of chatbot technology developments and stakeholder needs.

We argue that chatbot technology can not only be applied to e-commerce or e-government but can also improve the quality of the e-learning services that we are providing, especially in the post-COVID-19 pandemic era. Several recommendations and further works suggested by domain experts have also been highlighted in this paper, in order to improve our prototype further in the near future.

REFERENCES

- [1]David Guile. 2019. The Concept of ‘Recontextualization’: Implications for Professional, Vocational and Workplace Learning. *Learning, Culture and Social Interaction*. 23. (December 2019). <https://doi.org/10.1016/j.lcsi.2019.100343>.
- [2]Kitson Alison. 2020. Teachers as Recontextualization Agents: A Study of Expert Teachers’ Knowledge and Their Role in the Recontextualization Process across Different Subjects. (January 2020). UCL PhD thesis.
- [3]Liping Deng and Allan Yuen. 2011. Towards a Framework for Educational Affordances of Blogs. *Computers & Education*, 56, 2, 441-451. <https://doi.org/10.1016/j.compedu.2010.09.005>.
- [4]Tseng, Hsiao-Ting, Li-Kun Huang, and Chen-Chiung Hsieh. 2020. No More Fear of Every Snake: Applying Chatbot-Based Learning System for Snake Knowledge Promotion Improvement: A Regional Snake Knowledge Learning System. *International Conference on Advanced Learning Technologies (ICALT)*. (July 2020), 72–76. 10.1109/ICALT49669.2020.00029.
- [5]Yin Jiaqi, Tiong-Thye Goh, Bing Yang, and Yang Xiaobin. 2020. Conversation Technology with Micro-Learning: The Impact of Chatbot-Based Learning on Students’ Learning Motivation and Performance. *Journal of Educational Computing Research*, 59, 1 (March 2021), 154–177. <https://doi.org/10.1177/0735633120952067>.
- [6]Kim, Stansfield, Freeha Azmat, Graeme Knowles, Chris Evans, Devon Alcoat & Glenn Mazur, . 2018. Improving Technology Enhanced Learning (TEL) Selection & Deployment Using Modern QFD: A Virtual Reality Case Study. *International Symposium on QFD (ISQFD)*, (September 2018), 112-135.
- [7]Patchara Vanichvasin. Chatbot Development as a Digital Learning Tool to Increase Students’ Research Knowledge. *International Education Studies*. 14, 2, (January 2021), 44–53. <https://doi.org/10.5539/ies.v14n2p44>
- [8]Makhkamova, Ozoda, Lee, Kang-Hee, Do, KyoungHwa and Kim, Doohyun. 2020. Deep Learning-Based Multi-Chatbot Broker for Q&A Improvement of Video Tutoring Assistant. *International Conference on Big Data and Smart Computing*. (February 2020), 221–224. <https://doi.org/10.1109/BigComp48618.2020.00-71>
- [9]Gonda, Donn Emmanuel and Chu, Beatrice. 2019. Chatbot as a Learning Resource? Creating Conversational Bots as a Supplement for Teaching Assistant Training Cours. *International Conference on Engineering, Technology and Education (TALE)*, (December 2019), 1-5. <https://doi.org/10.1109/TALE48000.2019.9225974>
- [10]Moraes Neto, Antonio Justiniano and Fernandes, Márcia Aparecida. 2019. Chatbot and Conversational Analysis to Promote Collaborative Learning in Distance Education. *International Conference on Advanced Learning Technologies (ICALT)*, 2161–377X, (July 2019), 324–326. <https://doi.org/10.1109/ICALT.2019.00102>.
- [11]ISO 16355-1:2015. Applications of statistical and related methods to new technology and product development process – “Part 1: General principles and perspectives of Quality Function Deployment (QFD)”, Geneva, Switzerland: International Standards Organization. 2015.
- [12]ISO 16355-2:2017. Applications of statistical and related methods to new technology and product development process - Part 2: Acquisition of Non-quantitative Voice of Customer and Voice of Stakeholder, Geneva, Switzerland: International Standards Organization. 2017.
- [13]BotMock, Retrieved October 18, 2021 from <https://botmock.com/>
- [14]JISC, Retrieved October 18, 2021 from <https://www.jisc.ac.uk/guides/getting-started-with-accessibility-and-inclusion>