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Advancing Education through Stakeholder Engagement: An Evaluation of the Learning Butler Chatbot's Impact on Instructors, and Learners

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Abstract: This study aims to address the limitation of existing chatbots in education, which are designed only for learners and do not account for the needs of instructors. To solve this problem, the study proposes a learning chatbot called the "Learning Butler," which integrates resources for optimal learning outcomes and is developed based on the situational theory for mobile and classroom learning environments. The effectiveness of the Learning Butler in improving learning outcomes was evaluated through an experiment conducted at a university of science and technology. The results demonstrated that the Learning Butler significantly improved learners' performance compared to the general chatbot, and learners and instructors provided positive feedback on its ability to offer instant suggestions and feedback during dialogues and interactions. This research contributes to the development of effective educational technology by exploring the potential of chatbots in enhancing learning outcomes, with the ultimate goal of improving the quality of education through the application of advanced technologies and innovative pedagogical approaches.

Keywords: Chatbot in education, Social chatbot, Situational learning, Mobile situated learning, Butler

1. Introduction

1.1 Background

Chatbots have become increasingly popular in education due to their ability to integrate teaching content, provide real-time assistance, and enhance learning engagement (Okonkwo & Ade-Ibijola, 2021). However, most existing chatbots for education are designed only for learners and do not account for the needs of other stakeholders, such as instructors, which can limit their effectiveness. In addition, based on the situated learning theory, through dialogue interaction with roles shaped in physical or digital ways, instructors can overcome the limitations of time and space, and provide learners with real situations to apply their classroom knowledge in a low-cost and convenient way (Dede, 2009).

To address this limitation, this study proposes a learning chatbot called the "Learning Butler," modeled after the role of a butler, to serve as a communication bridge among stakeholders. Through the Learning Butler, learners can receive assistance with time management, emotional management, and encouragement to achieve learning goals.

1.2 Research Objectives

In this study, our main objective is to develop a learning dialogue chatbot, i.e., the Learning Butler, designed as a butler role for learning and modeled after the situated learning theory.

We aim to propose design methods for a learning chatbot that can serve as a communication bridge among stakeholders, integrate various resources, and achieve optimal learning outcomes. The ultimate goal is to enhance the quality of education through the application of advanced technologies and innovative pedagogical approaches.

1.3 Research Questions

To achieve the research goals, the research questions are designed to address the following inquiries: (1) Does the learning butler chatbot lead to better improvements in learners' learning achievements compared to a general chatbot? (2) Does the learning butler chatbot enhance learners' learning motivations and sense of responsibility to a better extent than a general chatbot?

2. Related Work

2.1 Application of Chatbot in Education

Chatbots have been recognized as a promising tool for improving education by addressing the problem of insufficient manpower (Winkler & Söllner, 2018). Additionally, chatbots have been found to be helpful in language learning, especially for beginners (Yin & Satar, 2020). Pham et al. (2018) designed a chatbot that assisted English language learners with general greetings, answering specific user requests, providing tips for learning content, and sending reminders to users. However, maintaining learners' enthusiasm for learning has been identified as a challenge in educational chatbot applications (Fryer et al., 2017). Furthermore, research has indicated that the inability to express understanding to users and the lack of emotion in chatbots may hinder their effectiveness in teaching (Gallacher et al., 2018).

2.2 Situational Learning

Situational Learning emphasizes that learners should acquire knowledge and skills in applied contexts, based on the concept of Situated Cognition proposed by Brown et al. (1989). Dede (2009) suggested that virtual environments can be utilized to optimize the implementation of situational learning by simulating learning situations that are not easily accessible in the real world. Cognitive Immersive Language Learning Environment (CILLE) is an example of a virtual environment that combines artificial intelligence with augmented reality technology, allowing learners to learn Chinese by interacting with AI agents in a situational learning environment (Divekar et al., 2021). In contrast, Huang et al.'s (2016) study showed that using mobile devices for situational learning resulted in better learning outcomes. Furthermore, some studies suggest that mobile learning has a lasting impact on learners' learning outcomes and can induce positive emotions such as excitement and happiness during the learning process for up to six months after the experiment (Demir & Akpinar, 2018).

2.3 Butler and Social Chatbot

Social chatbots have the potential to establish an emotional connection with users and provide a sense of social belonging, which can enhance users' engagement in longer and deeper conversations with the chatbot (Zhou et al., 2020). While social chatbots have been applied in various fields, their potential in the education field, particularly as companions and emotional support during learning, remains largely unexplored (Liu et al., 2022).

On the other hand, butlers, in general, are known for their excellent communication skills, organizational abilities, discretion, attention to detail, and active listening skills. These qualities make butlers suitable for supervision, companionship, and learning assistance, yet few studies have applied the butler model to design chatbots for the education field. To fill this gap, this study proposes a learning butler chatbot designed to assist learners with time and

emotion management, step-by-step completion of in-class and after-class exercises, and situational learning environments.

3. System Design

3.1 System Structure

The system structure of the learning butler chatbot comprises two platforms: the classroom situational learning system and the mobile situational learning platform. The chatbot provides learners with eight functions through its user interface, including time management, emotion management, positive reinforcement, learning goal prompts, multiple-branch scripts, dubbing management, manual evaluation, and a reward mechanism (Figure 1). These functions are intended to create a positive and supportive learning environment by providing learners with emotional support, time management, and rehearsal opportunities. Learners can interact with the chatbot through the classroom situational learning system, or interact with the practice website and learning butler chatbot via their mobile devices, enabling them to practice and review what they have learned at any time and place.

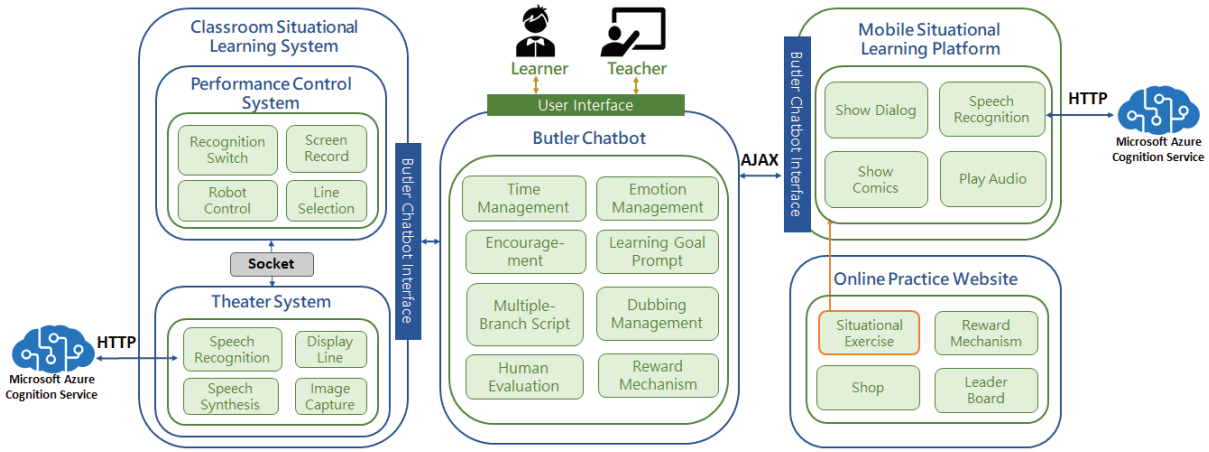

Figure 1. System structure.

The general chatbot, in contrast, only has basic dialogue functionality, limiting it to three functions: multiple situational scripts, manual evaluation, and a reward mechanism. For the other five functions, instructors provide support by reminding learners of homework before class, actively understanding learners' emotions, giving verbal encouragement to the whole class, informing learners of learning goals before the class starts, and changing the tone of voice promptly according to learning content or learners' situations. The multiple-branch scripts used in general chatbots only provide situational information through text and audio files, without situational information provided by pictures such as comics, and without the initial evaluation provided by the chatbot.

3.2 Implementation

The implementation of the classroom situational learning system is based on a digital learning theater design (Hu, 2021) and includes both a learning butler chatbot and a general chatbot. To enable effective rehearsal, multiple branch scripts have been added. Additionally, and Microsoft Azure's speech-to-text service is used for preliminary assessment by the learning butler chatbot. Customized features in the voice assistant's database provide reminders, positive reinforcement, emotional support, and feedback to reduce anxiety and enhance learners' confidence during rehearsal.

Regarding the mobile situational learning platform, respectively including the general chatbot and the learning butler chatbot. After selecting the script, learners are briefed on the

learning butler chatbot or general chatbot rehearsal processes. When entering the scenario rehearsal, the learning butler chatbot first informs the learner of the learning goals and the upcoming learning schedule, then provides positive reinforcement, scenario comics, demonstration audio files, and allows learners to record specific lines. Following the scenario rehearsal, the learning butler chatbot offers emotional support to learners (Figure 2).

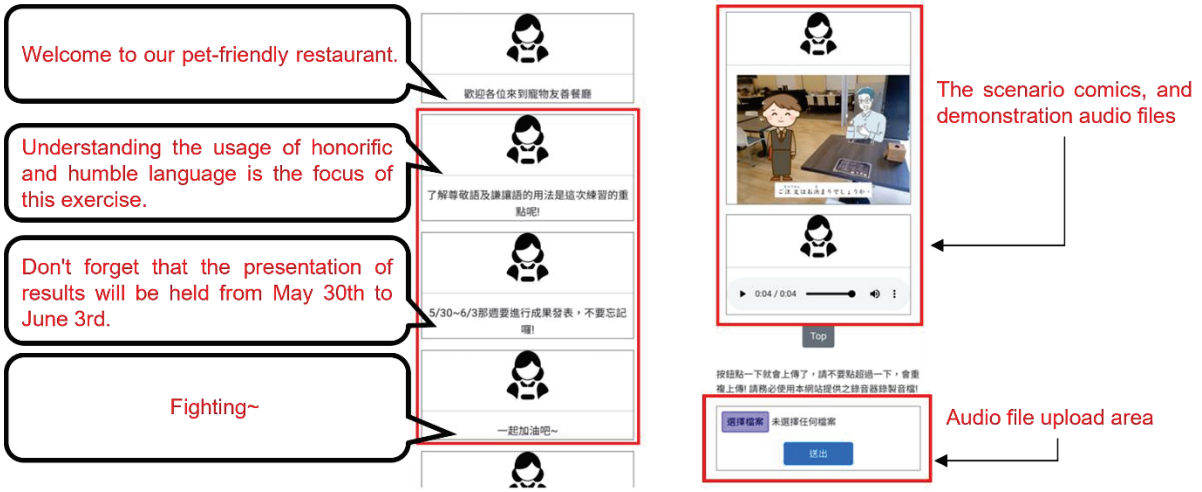

Figure 2. The learning butler chatbot reminds learning goals and provides positive reinforcement. Also, the scenario comics, and demonstration audio files are provided.

4. Experiment

4.1 Experimental Subject

In this study, a total of 60 undergraduate students in a Hospitality Japanese course at a local university of science and technology were recruited. The students were randomly assigned to either the experimental or control group, with 30 learners in each group. The experimental group consisted of 16 males and 14 females, while the control group was composed of 10 males and 20 females. Throughout the experiment, the two groups remained completely independent of each other and had no impact on each other's performance. The learning material for the system is a restaurant script compiled in Japanese with the assistance of the instructor of the Hospitality Japanese course.

4.2 Experimental Process

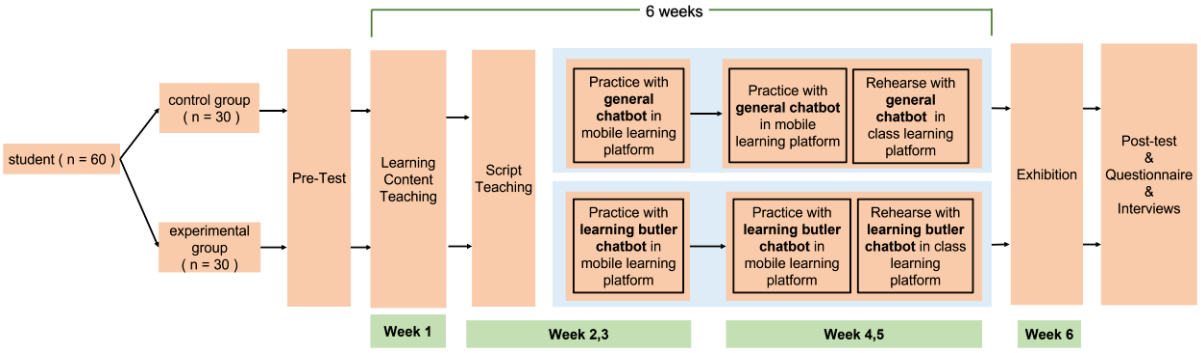

Figure 3. Experimental Process

The experimental process (Figure 3) spanned six weeks and consisted of several stages. A pre-test was conducted before the experiment began. Basic knowledge teaching took place in the first week to establish a solid foundation. In the second and third weeks, script teaching

was conducted, and learners used the mobile situational learning platform. The experimental group used the learning butler chatbot, while the control group used the general chatbot. In the fourth and fifth weeks, learners rehearsed their presentation using the classroom situational learning system. The experimental group used the learning butler chatbot, and the control group used the general chatbot. In the final week, learners presented their achievements using the classroom situational learning system. At the end of the experiment, all learners completed a post-test and questionnaires. Some learners were selected for interviews to gain deeper insights into their experience.

4.3 Research Instrument

To evaluate the effectiveness of the learning butler chatbot, the study employed a pre-test and a post-test before and after the experiment, as well as a questionnaire administered during the post-test. The tests were developed in collaboration with the Hospitality Japanese course instructor and included multiple-choice, true/false, and fill-in-the-blank questions related to the course content, with a maximum score of 100. The pre-test aimed to gauge learners' prior knowledge, while the post-test aimed to measure the impact of different learning chatbots on learning effectiveness, analyzed using ANCOVA. In addition to the tests, a Likert five-point scale questionnaire was used to gather data on learners' perceptions of the learning butler chatbot. The questionnaire included 17 questions covering five dimensions, four of which measured the elements proposed by the ARCS motivational model: attention, relevance, confidence, and satisfaction (Keller, 1987). The fifth dimension assessed learning responsibility and was developed by the researchers after review by experts.

5. Result and Discussion

ANCOVA was employed to compare the experimental and control groups in post-test scores with pre-test as covariate. The results show that the average and adjusted average scores of the experimental group are 82.40 and 81.70, respectively, while those of the control group are 72.16 and 72.85, respectively. Furthermore, there is a significant difference between the two groups ($F = 6.255$, $p = .015 < .05$). The partial eta square value was .099, with a range from .058 to .138, which indicates the effect size is at a medium level (Cohen, 1992). The data indicate that using a learning butler chatbot can significantly improve learners' performance compared to a general chatbot.

The questionnaire, with a Cronbach's Alpha score of 0.986, indicated high reliability. The results of independent sample t-tests revealed no significant differences between the experimental and control groups, implying that the use of a learning butler chatbot did not affect learners' motivation and learning responsibility.

This study conducted follow-up interviews with four learners and the instructor who participated in the experiment. The majority of learners believed that the learning butler chatbot played a supervisory role and increased their interest in learning. However, a small number of learners felt that general chatbots helped them enter a state of focused learning, which may explain why no significant differences were shown in the five dimensions of the post-questionnaire. Regarding the instructor, she emphasized the unique feature of the learning butler chatbot, which is its ability to determine whether learners are using the correct tone and style of Japanese during dialogues and interactions, and offer instant suggestions and feedback.

6. Conclusion

This study introduces a new learning approach using a learning butler chatbot on mobile and classroom situational learning platforms. It integrates resources, enhances communication efficiency, and enables real-time understanding of learners' needs for personalized and adaptive learning. Learners benefit from time and emotion management and a situational

learning environment, while instructors can conveniently plan, track progress, and provide individualized support. The results of this study show that using a learning butler chatbot significantly improves learning performance without negatively impacting learners' motivation and responsibility. Additionally, the majority of the interviewed learners and instructors provided positive feedback.

For future research, psychological theories and user experience should be considered to meet different learning needs, and more interactions should be integrated, such as adding texts and images to the mobile situational learning platform or incorporating facial recognition into the classroom situational learning system to provide more interactive experiences.

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