Exploring the use of chatbot to promote online EFL students' behavioral, cognitive, and emotional engagements

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Abstract: The implementation of online learning is often beset with the challenge of student disengagement, especially in online language learning where active learner practice is expected. To address this problem, we explored the use of a chatbot to support students with their English as a Foreign Language (EFL) listening learning in an online undergraduate course. The Self-determination theory was adopted to design the chatbot. Students were invited to interact with the chatbot for ten days to practice their English listening skills. A mixed-methods design was used to measure students' behavioral engagement, cognitive engagement, and emotional engagement. The results indicated students' positive online learning experiences with the chatbot. We also conducted follow-up interviews with students to determine their perceptions of learning with the chatbot.

Keywords: Self-determination theory, chatbot, online learning, language learning

1. Introduction

Over the past few decades, online learning has been viewed as a weaker alternative, and often stigmatized as a lower-quality form of education, compared to traditional face-to-face instruction (Hodges et al., 2020). However, due to the disruption caused by Covid-19, many countries are forced to switch to online learning (Barron Rodríguez et al., 2020). Educators had to employ online learning approach during the pandemic to sustain school education. Today, despite the end of the pandemic, the increasing of online learning has exceeded our expectations and grown in importance. Nonetheless, the persistent issue of student disengagement in online learning should not be overlooked (Dumford & Miller, 2018). Student disengagement refers to students' low participation or interest in the learning activities, which negatively impacts their online learning performance. This problem also exists in online language learning (Ji et al., 2022), where students need to master the language skills by actively practicing the specific skill. Previous studies have identified several challenges that affect students' engagement in online language learning, such as the lack of autonomy (Jiang & Peng, 2023), insufficient interactions (Tran, 2018), and inadequate teacher instruction (Indartono, 2019). One way to address this issue is to provide students with chatbots in their online language learning (Hew et al., 2023).

Chatbots, dialogue systems that interact with users via text or voice, are used primarily for language learning in education, particularly English learning. Previous research has demonstrated the positive effects of chatbots as conversational partners for students' language learning, with experimental groups showing significant performance improvements (e.g., Jeon, 2021). While some studies (e.g., Hew et al., 2023) highlight the potential of chatbots to enhance student engagement, others (e.g., Liu et al., 2022) found no significant impact on student interest in English reading activities. Given these mixed results, further research is needed to determine the effectiveness of using chatbots in language learning.

Existing studies (e.g., Yang et al., 2022) have primarily focused on chatbot applications in speaking, reading, and writing, with limited empirical research on the use of chatbots to improve students' EFL listening comprehension.

In this study, we used a chatbot as an interlocutor for EFL listening learning in an online listening course. The present study mainly aimed to investigate the impact of the chatbot on student engagement. Student engagement has broadly been described as a multidimensional concept that encompasses three main domains: behavioral, cognitive, and emotional engagement (Cooper, 2014). Behavioral engagement refers to students' participation in learning and academic assignments (Fredricks et al., 2004). Cognitive engagement concerns the level of students' desire to go beyond the course requirements in the learning (Fredricks et al., 2004). Emotional engagement was described as students' affective responses, like interest, satisfaction, and sense of anxiety (Fredricks et al., 2004). Additionally, we explored suggestions from students to further optimize the effectiveness of the chatbot in online language learning. This study is guided by the following research question: **What is the effect of the chatbot on students' engagement (behavioral, cognitive, and emotional engagements) in online English listening learning?**

2. Design and development of the chatbot

In this study, we designed the chatbot based on self-determination theory (SDT) aiming to engage students in online English listening. Engagement is considered an observable outcome of motivation (Reeve, 2012). SDT is a widely used theory for motivational development and psychological needs to deepen understanding of how and why individual behavior occurs (Deci & Ryan, 1985). SDT assumes three vital and inherent human needs that drive action: Autonomy, Competence, and Relatedness (Ryan & Deci, 2000). The need for autonomy is concerned with the desire of people to be causal agents and to have volition in their behavior (Ryan & Deci, 2000). More specifically, students' demand for autonomy can be satisfied if they can freely choose to make an extra effort or not. Competence pertains to whether one's pursuits or learning can be effectively mastered (Helme & Clarke, 1998). In the educational setting, students feel more competent when they can address the challenges of assigned tasks. Relatedness can be defined as students' desire to feel associated with others and to own a sense of belonging (Ryan & Deci, 2000). In teaching and learning, students have an imperative desire to interact with their peers and instructors. Figure 1 shows the chatbot interface.

Figure 1. Chatbot interface.

The autonomy in students' learning was achieved by an optional learning journal activity in the chatbot system, where students could reflect on their daily learning experiences. The chatbot prompted students to express their learning difficulties or reflections, by saying "How's your learning today? Any difficulties?". We considered students' journal writing as the indicator of their autonomy because they controlled the learning behaviors (deciding whether or not to write and what materials to reflect upon).

Competence was attained through three approaches: instructor-designed explanation videos, targeted feedback, and task instruction. First, the chatbot would deliver an instructor-

designed video that included the key points of each listening practice, helping students to comprehend the listening materials. Second, the chatbot would provide targeted feedback in terms of students' input. For example, if students misspelled a required word, the chatbot would respond with target feedback, such as "The spelling of this word is not complete." Third, the chatbot could provide step-by-step instructions on each listening task during the interaction. This aimed to alleviate any confusion that students may encounter during the learning process and enhance their competence to master the listening skills. For example, the chatbot introduced the learning objectives and guided students to check learning content by saying "You may check the explanation video below."

To enhance relatedness, the chatbot used communication indicators such as emojis and encouraging prompts for human-like interaction. Emojis, which are widely used in digital communication (Boutet et al., 2021), can help the chatbot to express emotional responses. For example, the use of the celebratory emoji in a message, "Well done🥳", could help the chatbot convey more friendly features to students. In addition, encouraging messages were used to foster a positive learning environment. When students made a mistake, the chatbot would respond with, "Please try again. I believe you can do it!"

3. Research Design

Our target participants were 41 year-two undergraduate students at a large public university in northwestern China. The present study was conducted in a compulsory English course. The whole intervention lasted two weeks, and students needed to interact with the chatbot in ten days to practice English listening. Ethical approval to carry out the study was obtained from the author's university and consent was received from all participants. Table 1 summarizes the quantitative data collection methods used in this study. To further examine students' perceptions of using the chatbot, individual semi-structured interviews were conducted. Twelve participants attended the interviews voluntarily. A sample interview question was "How do you think about your learning with the chatbot?"

Table 1. *Data collection methods*

Measurements	**Quantitative data collection**
Behavioral engagement	Students' listening task completion rate, which refers to the number of students who complete the required task to the total number of students. Students learning records were collected.
Cognitive engagement	Students' learning journal completion rate. This is an optional learning record.
Emotional engagement	A 5-point Likert scales survey was conducted to examine students' social presence and interpersonal attraction in the chatbot (adopted from Li et al., 2016).

4. Results and Discussion

4.1 Students' Behavioral Engagement

There were forty-one students who participated in the online listening practice every day using the chatbot. As previously mentioned, students' behavioral engagement was measured by the completion rate of the required task. The descriptive statistics of students' behavioral engagement are depicted in Figure 2. The results revealed that the daily completion rate among students was relatively high and remained stable over the ten days (*Mean* = 82%, *Min* = 71%, *Max* = 88%).

Three key factors have been identified in students' interviews as the main drivers of students' high levels of behavioral engagement. First, all 12 students mentioned that the *immediate feedback* given by the chatbot encouraged them to complete the listening tasks, helping them to reflect and revise their previous inputs during the learning process. Besides, the chatbot alleviated the pressure students might feel while doing the assignments compared

with receiving feedback from a human instructor. For example, Student K mentioned that if they misunderstood the question or gave a wrong answer in front of their instructor, they may feel “anxious and shame”. When students experienced the chatbot providing them with immediate targeted feedback and multiple chances to answer a question, they showed a preference for “interacting with a chatbot while completing tasks” (Student C). Second, students were engaged by the *task completion function*. After completing the listening tasks, they were able to click a “completed” button and check their task completion status in the chatbot system. Clicking on this button every day provided students with “a sense of accomplishment and motivates students to continue by completing the tasks” (Student B). *Clear task instructions* from the chatbot helped students understand the learning goals in the daily tasks and “navigate their online learning easily” (Student D), which gave them a sense of mastery over the learning process.

These features were helpful in supporting students’ competence in performing the learning activities, which in turn facilitated students’ continued participation in the online listening learning. This finding is consistent with Niemiec and Ryan (2009) who indicated that students are more engaged in learning when their competence is supported.

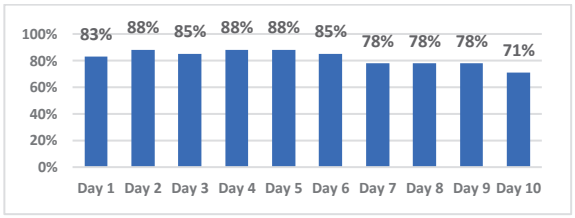

Figure 2. Student Task-completion Rate.

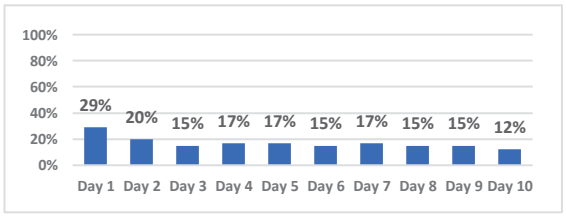

Figure 3. Journal Completion Rate.

4.2 Students’ Cognitive Engagement

We analyzed the learning journal completion rates to examine student cognitive engagement. Figure 3 shows a downward trend over ten days, with the rate dropping from 29% to 15% on the third day and then remaining low. There were 71% students not participating in writing the learning journal from the beginning.

Interestingly, despite the low level of cognitive engagement in the objective data, students in the interviews commented positively on the learning journal activities. Students valued the learning journal in the chatbot because of the increased sense of interaction in a community and the insights they could gain from others' experiences. For example, when students recorded their learning experiences, the chatbot quoted from previous students' learning journals, such as “Your seniors last semester also mentioned ‘Today's task was particularly challenging.’” In this case, the learning journal activity fostered a sense of connection with previous students that went beyond just interacting with the chatbot. They also indicated that sharing others’ learning experiences in the chatbot “served as a helpful reminder of important subject knowledge” (Student A) and provided “valuable insights into English listening learning” (Student K).

One explanation for this contradiction between the quantitative and qualitative data could be that students are not aware of the purpose of writing learning journals and its benefits. It should be noted that only 29% of the students wrote learning journals at the very beginning. The low participation indicates that a large portion of students (71%) may not have known that this activity existed. Nonetheless, more than half of the students who initially participated in this activity continued to write learning journals over time. The students who wrote the learning journals appreciated that the chatbot fostered a sense of a learning community by showing the experiences of previous students. Future designs should include an introductory session to the chatbot features and closer collaboration between teachers and the chatbot, with teachers explaining the pedagogical benefits of the chatbot learning activity.

4.3 Students' Emotional Engagement

A total of 33 students completed the surveys. Cronbach's alpha results for the social presence and interpersonal attraction scales were 0.96 and 0.95, respectively. Mean scores for social presence (*M* = 3.72, *SD* = 1.02) and interpersonal attraction (*M* = 3.61, *SD* = 1.06) were relatively high (see Table 2), indicating students perceived the chatbot as intelligent and interacted effectively. However, the third item of interpersonal attraction had the lowest mean of 3.48 (*SD* = 1.06), suggesting students held neutral attitudes towards spending additional time conversing with the chatbot after task completion.

Table 2. *Social Presence and Interpersonal Attraction Scales*

Scales	Items	Mean (SD)
Social presence (n = 33)	1. I felt as if I were interacting with an intelligent being.	3.76 (1.17)
	2. I felt as if I were accompanied by an intelligent being.	3.76 (1.06)
	3. I felt that the chatbot was able to respond to me effectively.	3.67 (1.05)
	4. I felt involved with the chatbot.	3.67 (0.96)
	5. I felt that I was able to communicate effectively with the chatbot.	3.73 (0.94)
Interpersonal attraction (n = 33)	1. I liked the chatbot.	3.70 (1.07)
	2. I think I could work with the chatbot.	3.76 (0.97)
	3. I would like to spend more time with the chatbot.	3.48 (1.06)
	4. I think the chatbot could be a friend of mine.	3.52 (1.15)

The interviews with students revealed several factors that were emotionally attractive and aversive. Students enjoyed interacting with the chatbot because the "conversations with the chatbot were relaxed and fun" (Student H) and the chatbot provided "a sense of companionship" (Student E). Two design elements contributed to their emotional engagement: Emojis and the storage of prior learning records. Emojis made the chatbot lively, while reviewing learning records provided students a sense of coherence in their learning journey.

A major shortcoming, however, was the chatbot's repetitive responses. All 12 students reported the pre-set repetitive responses that "made the difference between interacting with the chatbot and a real human" (Student F). The chatbot used the same prompts daily to guide students through the tasks, potentially diminishing their willingness to invest additional time interacting with the chatbot.

For future designs of using chatbots to facilitate students' emotional engagement, teachers are advised to employ a variety of prompts for the learning tasks and avoid repetitive instructions. The topics of the interaction can be beyond subject knowledge. For instance, chatbots can start the conversation with casual conversation rather than directly introducing the learning tasks. Non-verbal cues (emojis) can be used to express the chatbot's feelings.

5. Limitation and Conclusion

The current study has several limitations that suggest opportunities for future research. First, the short study duration of ten days could be extended in future research to examine student engagement in chatbot-supported learning over the long term. Second, the small sample of 41 students may not be representative of other contexts. Therefore, future studies should include larger and more diverse samples to evaluate the effectiveness of chatbots in online language learning.

In the present study, we designed a chatbot grounded on the SDT components for students' online English listening learning. Overall, students hold a positive attitude toward the implementation of the chatbot, which was suggested by their behavioral engagement, cognitive engagement and emotional engagement. However, the chatbot is not yet mature enough. Students proposed valuable insights in terms of both pedagogical and technological aspects, which will further help us to develop chatbots in the next round.

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