Investigating the Role of AI Book Talk Companion in Enhancing Student Performance: A Pilot Study on Self-Efficacy

Yi-Cheng TSAI[a*], Hsiao-Tung YANG[a], Chang-Yen LIAO[b], Yen-Cheng YEH[a] & Tak-Wai CHAN[a]
[a]*Department of Network Learning Technology, National Central University, Taiwan*
[b]*Department of Hakka Language and Social Sciences, National Central University, Taiwan*
*charlietsai11313@gmail.com

Abstract: This pilot study explores the potential of AI book talk companion to enhance students' self-efficacy, a critical factor in learning engagement, persistence, and academic achievement. The AI book talk companion system was designed to facilitate real-time interaction, providing immediate feedback and encouragement following students' reading activities. The study involved fourth to sixth-grade students, employing an exploratory design to assess the system's initial impact on their self-efficacy. While the findings did not indicate a significant increase in self-efficacy, there was a noticeable improvement in students' performance during book talk activities. This improvement suggests that the depth of interaction with the AI companion increased over time, with the quality of content output gradually approaching that of interactions with teachers. These preliminary results suggest that AI book talk companion hold promise for supporting student self-efficacy, meriting further investigation and application in educational settings.

Keywords: AI book talk companion, AI companion, Self-efficacy, Learning Companion

1. Introduction

In today's competitive and diverse educational landscape, fostering students' confidence in learning and providing innovative tools to support their growth have become increasingly important. Enhancing self-efficacy not only empowers students to engage in autonomous learning but also equips them with the resilience needed to overcome challenges and develop critical thinking skills. With the advancements in artificial intelligence (AI), we have integrated AI into a book talk companion system to enrich the learning experience further.

To closely mimic the experience of discussing books with a real person, our team has upgraded the previous text-based system by developing an AI-powered voice book talk companion. This system engages students in voice-based conversations, allowing them to participate in book talk independently, anytime and anywhere, without being constrained by the availability of teachers or parents. The AI companion provides real-time feedback and encouragement during discussions, effectively enhancing students' skills in articulation, comprehension, and critical reflection.

Additionally, this interactive process deepens students' engagement with the book's content, promoting a more comprehensive understanding of various concepts. After each discussion, the AI companion offers feedback that helps students gradually deepen their understanding of the material. Through repeated interactions, students can more quickly grasp core ideas and knowledge when reading subsequent books, ultimately aiming to enhance their self-efficacy. This study explores the potential benefits of using an AI book talk companion to

enhance students' self-efficacy, introducing it as a supplementary tool to create a more personalized and interactive learning environment that improves both learning outcomes and student interest.

2. Literature Review

2.1 Book talk activity

Book talk activities take place after reading a book. By engaging in conversations with others or using book talk tools, readers can gain a deeper understanding of the book's content. This process encourages students to approach and reflect on issues from multiple perspectives, thus deepening their understanding of the text (Pie Corbett, 2008).

Additionally, book talk require participants to clearly express their viewpoints and feelings, which helps to develop their oral expression skills (Jen Bengel, 2014). Research indicates that book talk play a crucial role in children's reading development (Merga, 2017). They can also significantly enhance students' social interactions and reading recommendations (Merga, 2018).

The findings suggest that book talk after children read can greatly support their learning development. Therefore, parents and teachers should actively promote and use high-quality book talk methods.

2.2 Self-efficacy

Bandura's self-efficacy theory defines it as individuals' belief in their ability to achieve a certain level of performance (Bandura, 1977). This theory emphasizes the perception and judgment of one's own abilities rather than actual competencies. In essence, it reflects one's confidence in their ability to accomplish goals. Students with high self-efficacy typically exhibit greater motivation, higher engagement, and better academic performance. They tend to set more ambitious learning goals and demonstrate better problem-solving skills and persistence when facing difficulties. Conversely, individuals with low self-efficacy are more likely to give up when challenged and may feel helpless in the face of difficulties.

Self-efficacy can be developed and strengthened through four main pathways: mastery experiences (achieving personal goals), vicarious experiences (observing others similar to oneself achieving goals), verbal persuasion (receiving positive feedback from others), and physiological and emotional states (one's physiological conditions and emotional responses).

According to Jackson (2002), self-efficacy beliefs are significantly correlated with exam scores and are influenced by effective communication methods. Furthermore, Chen (2020) confirmed a positive correlation between higher self-efficacy and students' proficiency in English. These studies underscore the significant impact of self-efficacy on students' academic achievements and performance.

In computer-supported collaborative learning environments, students' self-efficacy is closely related to both their task performance and the learning strategies they use (Wilson & Narayan, 2016). Therefore, educators should adopt effective learning strategies to enhance students' self-efficacy and promote their overall learning and development.

2.3 Artificial Intelligence in Education

With the growing demands for learning, the importance of artificial intelligence (AI) in education is increasing (Chassignol et al., 2018). AI applications in education, such as intelligent tutoring systems and learning analytics, can customize educational content to meet individual learning needs, thereby enhancing learning outcomes (Tiwari, 2023).

AI can enhance individual productivity by automating tasks and improve learning outcomes through personalized learning experiences. It also provides immediate feedback to

students and increases engagement by offering adaptive and interactive learning environments (Negoiţă & Popescu, 2023).

In the field of artificial intelligence applications in education, chatbots demonstrate significant potential by offering personalized interactions and enhancing the learning experience. AI-powered chatbots provide customized online learning and can assess students' understanding (Chen et al., 2020). For example, the AsasaraBot AI chatbot has been successfully utilized in teaching foreign languages and cultural content, showing their effectiveness in interactive learning environments. These chatbots enhance the learning experience by integrating content and language education (Mageira et al., 2022).

Moreover, AI-driven tools, including intelligent tutoring systems and chatbots, can significantly boost student engagement and learning outcomes by analyzing student data and offering personalized learning experiences (Yildirim & Celepcikay, 2021).

2.4 Learning companion

Chan and Baskin (1988) were the first to introduce the concept of learning companions. Learning companions not only provide support in learning but also facilitate interaction and communication, which, in turn, deepens understanding and enhances the application of learning content. The theoretical foundation of learning companions is rooted in social constructivism, particularly Vygotsky's concept of the "Zone of Proximal Development" (ZPD). This concept emphasizes that students can achieve higher learning levels by collaborating with more knowledgeable peers (Vygotsky, 1978). Research shows that learning companions offer numerous benefits, including significantly enhancing students' motivation and engagement, as well as improving learning outcomes and understanding (Gillies, 2004).

Learning companions can be classified into two types: formal and informal. Formal learning companions include collaborative learning groups and study circles within the classroom, which have been proven to effectively improve students' academic performance and understanding (Slavin, 2012). Informal learning companions, such as extracurricular tutoring and peer mentoring, provide additional learning support and opportunities for engagement outside the classroom (Topping, 2009).

Technological advancements have also promoted the development of learning companions. For example, AI-assisted learning companions provide personalized learning and rich educational resources, which help improve both students' learning efficiency and teachers' teaching quality (Niu et al., 2022). Studies have shown that learning methods involving chatbots can significantly enhance students' academic achievements and self-efficacy. For instance, research on nursing training found that students who used mobile chatbots outperformed those who relied on traditional teaching methods in both learning achievements and self-efficacy (Chang, Hwang, & Gau, 2021).

3. AI book talk companion

3.1 System Introduction

Our research team has developed an AI book talk companion system aimed at facilitating students' participation in post-reading discussions at any time and location. This system helps alleviate the time constraints faced by teachers and parents during these activities. We anticipate that regular interaction with the book talk companion will enable students to enhance their discussion abilities and expand their viewpoints over time. By providing support and affirmation, and by improving students' expressive abilities and comprehension through repeated interactions, we aim to boost students' confidence and sense of accomplishment. This approach will help them express their thoughts and internalized knowledge more confidently and thoroughly in future discussions with real people.

Previously, teachers had to document each student's performance and provide detailed feedback after each discussion, which increased their workload and made it difficult

for students to fully retain the feedback. The system's 'Analysis of Book talk Outcomes' and 'My Discussion Record' features address these issues effectively. They help parents and teachers gain insight into students' reading outcomes and support students in reviewing the content and suggestions from each discussion.

3.2 System Architecture Design

We have integrated this system into the reading platform that students use daily to log their reading activities. This allows students to independently use the book talk companion system for book talk after reading at both school and home. The interface we designed consists of three main parts: the Book talk Companion homepage, the Book talk page, and the analysis of book talk outcomes page. The homepage displays the main functional options of the system, the discussion page is used for conducting book talk, and the feedback analysis page provides feedback on the discussions to the students.

The book talk companion system primarily utilizes the GPT-3.5 API language model to generate responses and analyze content. It also incorporates the Speech Synthesis service from the Web Speech API, which facilitates voice interactions with students, simulating a realistic book talk experience. Additionally, the Whisper API is employed for speech recognition, converting audio recordings of student responses into text for further processing by the language model.

Furthermore, the system is integrated with a book selection platform, allowing students to conveniently choose their next reading material after book talk. This integration also displays each student's current book borrowing status and their interaction history with the AI book talk companion, aiding students in understanding their reading and book talk progress more effectively.

3.3 System Interface and Function Description

The "Book talk Companion System Homepage" offers two main functions: engaging in book talk and viewing discussion records. Students can either start a new book talk or review past summaries and recommendations provided by the companion on the "My Discussion Record" page. On the "My Discussion Record" page, students can find details such as book titles, discussion times, durations, book categories, and their self-assessment scores after each discussion. This information helps students evaluate their engagement level, track their interest growth, and identify any issues related to their reading preferences. By consistently participating in book talk, students can track their accumulated discussion records and improvements in scores, which supports their motivation and sustained interest in learning.

In this research system, the design takes into account that students use the platform frequently but for short durations each time. To prevent the potential monotony that could arise from interacting with only one type of learning companion, we have created three distinct learning companion personas. This approach is intended to cater to students' varied learning needs and offer a more engaging and personalized learning experience.

Upon entering the book talk page, students can choose from three different book talk companion. Each companion offers a unique discussion style and focuses on different book categories (see Table 1 for details). The three discussion methods available are: the 4F Reflection Method (Greenway, 1992), the K-W-L (Know-Want-Learn) Method (Ogle, 1986), and the Guided Book talk Method (developed by Tomorrow's Reading Initiative for School Development). The Guided Book talk Method involves four key steps: introducing the main content of the book, sharing details, relating the book to personal experiences, and applying and reflecting on the material. Students can learn more about each book talk companion and their methods by accessing the 'View Host Introduction' section. They can also select a discussion companion based on the category of book they wish to discuss.

Table 1. *AI Book talk Companion Design Correspondence Table*

Discussion Companion	Book Domain	Discussion Strategy	Design Rationale	
Zhuangzi	Stories and Novels	4F Reflection Method	-	Zhuangzi's works include vivid fables that are thought-provoking, and he is a well-known historical figure.
			-	The 4F Reflection Method helps students structurally understand stories and novels from multiple perspectives, enhancing their critical thinking and reading comprehension skills.
Su Dongpo	Humanities and Social Sciences Books	Guided Book talk Method	-	Su Dongpo was a Song Dynasty writer and poet with deep insights into literature and the humanities.
			-	The Guided Book talk Method can guide students to reflect on the plots, characters, and themes in humanities and social sciences books.
Zhuge Liang	Science and Technology Books	K-W-L Method	-	Zhuge Liang made significant contributions in strategy and technology.
			-	The K-W-L method, which emphasizes asking questions, acquiring knowledge, and drawing conclusions, is well-suited for guiding discussions on science and technology books.

After selecting a book, students can view a summary of the chosen book. This feature helps them confirm the book's details and refresh their memory of the content, which makes the subsequent book talk process smoother. Once the book is confirmed, students can start the book talk activity. Before beginning the book talk, each book talk companion has a unique approach to initiating the conversation by asking student-centered questions. This method aims to create a relaxed atmosphere and encourage genuine interaction, avoiding a quiz-like format.

During the book talk process, interactions primarily take place on the discussion page, where content is presented in a dialog box format. Students can click the microphone icon to provide spoken responses. The system automatically transcribes their speech into text and displays it in the input field, allowing students to review and correct the content before sending. The AI book talk companion responds with both text and synchronized voice replies. Students can listen to the companion's responses, which makes the interaction feel more human-like and helps students engage more effectively. When students feel that the discussion has reached a natural conclusion, they can choose to end the session or save it to continue later. After ending the discussion, the system then moves to the results analysis interface to evaluate the book talk.

The results analysis interface for book talks (Figure 1) displays the discussion duration, the transcript, and recommendations. Students can understand their level of engagement by reviewing the discussion duration and use the transcript to review key points from the discussion, thereby deepening their understanding of the book's content. Suggestions from the discussion help students improve future discussions and guide their reading choices. After completing a book talk, students can either enter the book selection system to choose a new book or return to the book talk companion interface to continue with another discussion activity.

Figure 1. Book talk Results Analysis Interface.

4. Research Methodology

4.1 Participants

The research subjects for this study were three classes of fourth to sixth graders from an experimental elementary school in Taoyuan: 12 students from fourth grade, 7 from fifth grade, and 18 from sixth grade, totaling 37 students. All participants had at least one year of experience with book talk.

4.2 Research Methods and Process

The research divides the experiment into three stages, with a two-week interval between each stage, and the entire experiment lasts for six weeks. During the experiment, students will operate the AI book talk companion system autonomously. At the same time, we will provide technical support on-site and observe the usage of the system.

Stage One involves the introduction of the AI book talk companion system. During this phase, the system focuses primarily on the content of the discussions. It provides the AI companion with basic book information, student information, and fundamental settings for the discussion methods of the companion. Stage Two aims to improve the AI book talk system based on feedback from students regarding the system's interactivity and the naturalness of the question-and-answer process. Enhancements include incorporating personality traits into the AI companions, adding style and individuality to interactions. Additionally, the AI now establishes rapport with students before discussions to make interactions more realistic. Stage Three focuses on further refining the AI book talk companion system. This phase addresses issues related to formulaic and shallow questioning. To tackle these problems, we replaced Chinese prompts with English prompts and used transitional phrases to better express requirements. These adjustments aim to reduce formulaic tendencies and increase the depth of questions, allowing the system to engage in more meaningful interactions based on students' previous discussion records.

5. Preliminary Results and Conclusion

To investigate changes in students' self-efficacy before and after using the AI book talk companion, this study employed a book talk self-efficacy questionnaire and analyzed the data using paired t-tests. The results indicated no significant overall change in self-efficacy, including in the dimensions of personal mastery experience, vicarious experience, and

physiological and emotional states. There was only a slight increase in the social persuasion dimension. The analysis of book talk and reading process data revealed that, students' participation in book talk has gradually increased, with the volume of content discussed also rising, indicating enhanced interaction and willingness to express themselves with the AI companion. Furthermore, fourth-grade students tend to focus on factual questions, while fifth and sixth graders increasingly ask questions related to feelings and discoveries.

Although quantitative data did not reveal significant changes in self-efficacy, qualitative analysis suggested that the AI book talk companion may have potential value. Following the experiment, we conducted semi-structured interviews with fifteen randomly selected participants to explore the AI's impact. The interviews focused on participants' experiences with the system, comparisons between interactions with AI and human counterparts, and any observed changes in learning outcomes and emotional responses.

During the interviews, most students (9 out of 15) expressed a positive attitude towards the AI book talk companion. They felt that this interaction method reduced the pressure of book talk and increased both freedom and enjoyment. For example, some students mentioned that the AI book talk companion does not exhibit negative emotions towards their responses, which allows them to express their thoughts more freely. Additionally, some students found the interaction with the AI book talk companion enjoyable, as the AI book talk companion use of voice interaction made the experience engaging and the voice itself interesting. Moreover, five students preferred discussing books with the AI companion, finding its immediate feedback helpful for future discussions. This feedback alleviated their concerns about making mistakes and reduced their anxiety during discussions with teachers after repeated use. Regarding the impact or feelings after using the AI book talk companion, six students noted that the many questions posed by the companion were very helpful for continuing in-depth discussions. Additionally, two students mentioned that the AI companion's concern for their mood and daily life before starting the discussion made the experience stand out compared to their usual discussions. One student also noted that the combination of subtitles and audio during the discussion significantly improved their literacy skills, helping them master the pronunciation of unfamiliar words.

In the negative feedback from students, four students expressed concerns about the system asking too many questions and the AI's voice being too monotone and fast, which affected their learning experience. Regarding the interactive interface, some students suggested changing the appearance of the learning companion to increase their willingness to use the system. Compared to human interaction, students generally felt that the AI lacked emotional communication and interactivity, and was unable to provide personalized advice and accurate book recommendations like those of a teacher. Additionally, some students reported that the AI's responses lacked accuracy, which made it difficult to understand the companion's feedback during discussions. Nevertheless, some students found the AI's occasional "random answers" amusing and believed it increased their learning interest.

The experimental findings suggest that although there was no significant improvement in self-efficacy from using the AI book talk companion, students showed a positive attitude towards using it for book talk and did not reject this method. Additionally, the AI book talk companion provided positive support in certain areas. However, it still needs improvement in interactivity, personalization, and accuracy to better meet students' learning needs and expectations for emotional engagement.

When assessing the impact of the system on students' self-efficacy improvement, we found that the effects were not as significant as anticipated, which may be attributed to several factors. Firstly, the implementation period of the system was too short, preventing students from fully adapting to and internalizing the new methods. The enhancement of self-efficacy is a gradual process that requires time; if the usage period is too brief, the system's full potential cannot be realized. Secondly, if the system's responses lack accuracy or relevance, it could undermine students' confidence and motivation. High-quality, personalized feedback is crucial for an enriching learning experience. The size of the experimental sample is also critical; if the number of participants is too small, it may result in statistically insignificant outcomes, thereby obscuring the system's true effectiveness. Lastly, if the virtual characters fail to resonate with students, the system's appeal could be significantly diminished. To foster sustained student

engagement, the virtual characters need to exhibit qualities such as approachability, intelligence, and personalization.

To address these issues, future improvements should include several key aspects. Firstly, extending the duration of the experiment to six months or a year would allow the system sufficient time to produce the anticipated effects. Extending the experiment would give students more time to adapt to the system and fully utilize its potential. Secondly, refining the system's prompts to enhance the accuracy of its responses would help improve students' focus and motivation to use the system, enabling them to receive more useful feedback. Thirdly, expanding both the number and diversity of participants would help ensure the results are significant and representative. A larger sample size can provide more reliable data and reduce the impact of random errors on the results. Lastly, considering the integration of animal companions in the design might help students build emotional connections with their learning partners, which could increase their interest and engagement in learning, enhancing their overall experience. Implementing these improvements could greatly enhance the system's effectiveness and enrich students' learning experience.

Acknowledgements

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