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Appropriating AI-Powered Pedagogical Affordances for Vocabulary Learning

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Abstract: In recent years, using AI to create an engaging vocabulary learning experience has been a prominent topic. Studies have shown AI can provide educational affordances for enhancing vocabulary learning. However, the appropriation of these affordances varies depending on teachers' use. This paper presents a case study on six teachers appropriated an AI-powered vocabulary learning system, particularly focusing on the affordances of monitoring and regulation, and engaging co-construction enhanced by AI-enabled automatic feedback and recommendations. By examining teachers' beliefs and knowledge of self-regulation and collaborative learning, the study details how they appropriated the affordances in their classes. The study provides suggestions for the design of AI in education and teachers' professional development during the implementation of AI-supported learning system.

Keywords: AI, vocabulary learning, affordance, appropriation, primary school

1. Introduction

Artificial intelligence (AI) applications have become increasingly popular in vocabulary learning, providing personalized and adaptive learning experiences to students. Studies have shown that AI has various educational affordances to support vocabulary teaching and learning. However, the innovative nature of AI does not guarantee effective or desired learning outcomes. The way in which teachers use AI tools and the interactive learning opportunities they generate significantly influence how well the educational affordances are appropriated (Amerian & Mehri, 2014). Extant studies have discussed and evidenced AI's education affordances in language learning (Crompton, et al., 2024). However, existing research lacks attention to how teachers appropriate these AI affordances in specific contexts. Therefore, this case study investigated how AI-powered educational affordances of a vocabulary learning system were appropriated by teachers with different teaching experiences and pedagogical beliefs. The findings of the study aimed to provide suggestions for teachers' professional development while implementing AI-supported learning system, as well as for AI-powered learning system design.

2. Literature review

Educational technology affordances have become an important factor in identifying learners' roles, opportunities, and interactions with technology (Kordt, 2018). Regarding language learning, scholars use affordances to describe the inherent language learning possibilities within a learning environment (Jeon, 2024). Various AI algorithms have been utilized in AI-enabled vocabulary learning tools. These tools aim to improve vocabulary learning and practice by offering features

like translation, grammar checking, automatic corrective feedback, and adaptive learning systems (Crompton et al., 2024).

Studies have demonstrated that AI possesses educational affordances that support vocabulary teaching and learning both inside and outside the classroom. Despite numerous studies focusing on the effectiveness of interactions between learners and AI-enabled vocabulary learning environments (Jeon, 2024), mediating these actions requires scaffolding by teachers, who create opportunities by designing, conducting, and managing educational technology activities and learning tasks (Amerian & Mehri, 2014). Therefore, understanding how AI is used and the affordances from teachers' perspective cannot be ignored.

The concept of appropriation implies "a tension between artifact-as-used and the tensions invested in the artifact by its designers" (Overdijk et al., 2014, p.284). The appropriation of affordance involves how users interpret and utilize the affordances offered by technology based on their needs, context, and prior experiences (Wen et al., 2015). On this basis, the present study aimed to explore how teachers appropriated AI-related educational affordances. The findings offered recommendations on how to effectively appropriate the design system to promote vocabulary learning, as well as suggestions for teachers' training on using AI-powered tools with similar educational affordances tailored to the same target learners.

3. Method

3.1 Participants

This research was conducted in six Primary 2 classrooms across three primary schools in Singapore (see Table 1). Six teachers participated in the study, and they all demonstrated a basic understanding of AI-enabled language learning tools and exhibited a positive and receptive attitude towards integrating ICT into their classrooms. They were willing to explore pedagogies-enabled by ICT despite concerns about overuse among lower primary school students. All teachers emphasized the importance of incorporating ICT into their teaching methods to enhance students' learning with ICT. Only Teacher B expressed anxiety about integrating ICT into the classroom due to worries about managing potential technological issues.

Table 1. *Details of Participants*

Teacher	Year of teaching	School	Class	Number of students
A	3	B	1	18
B	20	B	2	21
C	11	X	3	22
D	15	X	4	19
E	10	T	5	30
F	4	T	6	30

3.2 ARCHe System and its AI-related Educational Affordances

This study was based on teachers' use of an AI-powered Chinese vocabulary learning system (named ARCHe) for primary 2 students whose Chinese is their second language. The ARCHe system includes both home-based and class-based learning tasks to bridge students' class learning to everyday life. More details about the ARCHe system design can be in the previous publication (Wen, 2022). In this study, two educational affordances of ARCHe, powered by AI, are emphasized. First, ARCHe enables ***monitoring and regulation*** as it provides automatic

feedback on pronunciation and handwriting to assist students in completing individual home-based tasks, by which students can monitor, regulate, and reflect on their work progress with the feedback provided. Fig 1 shows examples about automatic feedback by recognizing and assessing the students' handwritten Chinese characters, and automatic feedback is provided based on the accuracy of students' pronunciation.

a) automatic feedback for handwriting *b)* automatic feedback for pronunciation

Fig 1. automatic feedback

Second, ARCHe has the affordance of ***engaging in co-construction*** by providing automatic recommendations for small groups of students to promote collaborative learning. During the class-based collaborative learning task, students label an area in a given scenario picture and construct a sentence to describe it. As groups submit their artifacts, the system provides automatic recommendation by extracting keywords and recommends related artifacts generated during home-based learning activities for reference (Fig 2). Students can incorporate previously generated sentences into new scenarios, and in this way, they are encouraged to maintain a common ground, build on each other's contribution, and co-construct a shared understanding.

Fig 2. automatic recommendation

3.3 Data Collection and Analysis

Each class took part in the project for one semester (10 weeks), with four one-hour class-based ARCHe vocabulary learning lessons conducted approximately every two weeks. Before each session, students were required to complete specific home-based learning tasks. All ARCHe lessons were video recorded. The researcher adopted a qualitative approach to investigate if and how teachers appropriate the pedagogical affordances of ARCHe in vocabulary learning classes.

The data sources include teachers' pre- & post-interviews and class videos. Both interviews were conducted with semi-structured method, ranged from 30 to 45 minutes, and were recorded in both video and audio formats. Additionally, ARCHe lesson video recordings were collected from four class-based vocabulary learning tasks across six classes, resulting in 24 lesson videos, each approximately 60 minutes long, including teachers' briefings, instructions during tasks, and class-end conclusions. The semi-structured interviews served as the primary data source, supplemented by video recordings of ARCHe lessons to enrich the teachers' comments, particularly regarding their instructional experiences when students interacted with the ARCHe learning system.

Thematic analysis was conducted to analyze the interview data. Initially, an open coding approach was employed to identify and categorize themes and patterns in the data. Researchers thoroughly reviewed each interview transcript to identify key concepts, ideas, and recurring topics. Episodes based on video data were provided to translate the findings of the interview data.

4. Findings and Discussion

4.1 The Enhancement of Learning Agency is the core of Automatic Feedback

The home-based individual learning tasks of ARCHe, powered by automatic feedback towards pronunciation and handwriting, was designed to facilitate ubiquitous vocabulary learning and improve students' learning agency by enabling learners' monitoring and self-regulation. After the intervention, all the teachers agreed that this immediate feedback along with corrections and explanations, can effectively assist students with diverse learning abilities in completing home-based foundational learning tasks.

However, our findings revealed that using ARCHe for monitoring and regulating one's own work was much more emphasized by Teacher C and Teacher D, compared to other teachers. Teacher C actively encouraged students to complete foundational tasks independently at home. Additionally, she also used the system to monitor students' performance and provided feedback to students to encourage their participation in completing ARCHe-based tasks. At the beginning of every ARCHe class, Teacher C rewarded the best-performing students in home-based tasks according to the dashboard data. Teacher D also emphasized that automatic feedback can enhance young learners' independence and promote self-correction awareness, reducing their reliance on parents or teachers for assistance.

> When students use it, they don't struggle to complete tasks and give up easily. They also don't need to constantly seek help from their parents, relatives, or teachers for guidance (Teacher D).

However, as we observed, when using the dashboard data, Teacher A and Teacher B placed a strong emphasis on summarizing and correcting student errors in home-based learning tasks. They make little use of rewards to motivate students in home-based learning. During the post-interview, regarding the function of automatic feedback, Teacher F highlighted the importance of AI-enabled handwriting recognition, noting that the system is sensitive to students' handwriting neatness. Her interpretation of this feature was that if a student's handwriting is not clear, it may be recognized as an error, thereby it can encourage students to practice writing Chinese characters neatly.

> I appreciate the writing feature where students write on a blackboard shaped like a little cartoon cloud. This feature is beneficial as it requires students to write neatly, with the system recognizing errors if handwriting is not clear. (Teacher F).

These findings suggest that if the teachers' focus is only on the accuracy of the feedback provided by AI, without further emphasizing the pedagogical affordance such as mentoring and regulation

it provides, the use effectiveness may be affected. The way teachers appropriate the tools may also affect students' attitudes towards the tools, thus influencing their engagement.

4.2 The Belief in Collaborative Learning Affects Human and AI Interaction Implementation

Regarding ARCHe class learning tasks, it is worth noting that Teacher C, D and E, who have a strong belief in collaborative learning, frequently used automatic recommendations. These three teachers not only modeled how to use the recommended to enrich group sentences but also encouraged students to take note of recommended sentences that were created by others to improve own group work continuously. Both Teacher C and Teacher D emphasized the importance of improving students' attitudes and the collaborative learning process during ARCHe activities rather than solely focusing on learning outcomes.

> Grouping is crucial during ARCHe activities to avoid potential issues among students and encourage them to refine and improve their sentences (Teacher C).

> I guide students on how to resolve disagreements through negotiation during the ARCHe activity, helping them enhance their problem-solving skills (Teacher D).

Conversely, Teacher A and Teacher F, who had not conducted collaborative activities in their classes before using ARCHe, expressed great concerns about classroom management. They emphasized the number of tasks that students had to complete and limited the use of automatic recommendations. In post-interviews, they both mentioned that beginner learners may benefit more from learning directly through exemplary sentences from textbooks or experts. They also expressed their concerns about young leaners' readiness of goal-oriented discussions.

Though our video data shows that students of this age group can be easily distracted by the automatic recommendation, they were also able to make use of the recommended sentences to improve their group work, especially with guidance from teachers. Below is an episode that occurred in Teacher E's class, where, promoted by Teacher E, the group incorporated the recommended word into their own sentence.

> Student 1: "What is this?"
> Student 2: "It's my sentence."
> Student 1: "Look at here, the cat is so cute." (Pointing to the sentences under label '小猫 kitten')
> Student 3: "I don't like the cat."
> Student 2: "It's scary, wow!"
> Teacher E: "你可以用这些句子，看看这些句子怎么做的？是不是可以帮助你造句?" [look for these sentences, to check if these sentences can give you inspiration]
> Students 1, 2 & 3: Students read out the sentence.
> Student 1: "小猫，在玩……这是什么?" [kitten is playing…. what's this?]
> Student 2: "皮球[ball]，you see this sentence has 皮球[ball]，that's what we forgot to write."

Using AI to promote human-machine conversations has attracted significant attention (Jeon, 2024). Technologically, with advancements in generative AI, chatbots can be fine-tuned to understand and adapt, providing comprehensive support for more complex tasks and inquiries. The AI-powered affordances to engage in co-construction will be further enhanced by fostering goal-oriented discussions between the agent and learners, or among learners. As a result, enhancing teachers' pedagogical knowledge of collaborative learning during the implementation of AI-powered collaborative learning will be crucial.

5. Conclusion

This study investigated how teachers appropriate AI-powered pedagogical affordances of a Chinese vocabulary learning system. The findings suggest that teachers play a crucial role in guiding students to effectively use the AI features. With the advancement in generative AI, the hybrid intelligence between AI and teachers will be further underscored (Bredeweg & Kragten, 2022). The study on how teachers appropriate AI affordances may provide strategies to inform system design and tailor AI-enabled scaffoldings that align with instructional goals and student needs. This is also a hybrid intelligence approach that holds great promise for revolutionizing education by harnessing the collective power of human expertise and technological innovation.

There are several limitations in this study. Firstly, due to space constraints, more detailed case descriptions could not be provided. Secondly, the data of this study consists of teachers' interview data and video-based observation data. Student interview data could be used to triangulate the findings of the study, but it was not included in this paper. Lastly, this study merely described how teachers appropriated the AI affordances without exploring the correlation between the appropriation and learning outcomes. Future studies will include student learning process and performance data to address these gaps.

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