Anusandhanvallari
Vol 2025, No.1
January 2025
ISSN 2229-3388

Beyond the Desktop: Assessing Computer-Based Reading Comprehension in the Age of Ubiquitous AI

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Abstract

Language education in the digital world has moved beyond simple desktop learning tasks to a rich ecosystem of pervasive Artificial Intelligence (AI) and Mobile Assisted Language Learning (MALL). In this research, the researcher investigates the computer-based reading comprehension in this transformative era with emphasis on Intelligent Computer-Assisted Language Learning (ICALL). The research is based on pedagogical theories such as Merrill's First Principles of Instruction (FPI) and Activity Theory, which guide the examination of how AI agents act as socio-pedagogical scaffolds. Results have shown that AI can boost personalization by adapting content, making it easier or more challenging based on the individual's level of proficiency. They also help in incidental vocabulary and enhance learner engagement. The use of generative models such as ChatGPT can lower the language learning anxiety and increase the level of learner autonomy. But even with these machines, there are still “data failures” when they work to "understand" the subtle socio-cultural context. Also, there are some technical problems such as small screen size, which could make MALL less effective than CALL in the intensive reading activities. The research results indicate that in order to evaluate comprehension, holistic interaction between the learner and the intelligent agent must be analyzed. Implementing this successfully requires the ability to compensate for the computational ability of AI with the qualitative understanding of human educators.

Keywords: Artificial Intelligence (AI), Reading Comprehension, ICALL, Personalization, Adaptive Learning, Learner Autonomy, Instructional Design, CALL.

Introduction

Language education teaching and learning have experienced a radical transformation from the initial use of mainframe computers to the present day of pervasive Artificial Intelligence (AI) and mobile-assisted teaching and learning contexts. From the simple stimulus-response drills of traditional computer-assisted language learning (CALL), it has progressed to intelligent computer-assisted language learning (ICALL), which uses technologies such as Natural Language Processing (NLP) and Large Language Models (LLMs) to mimic human interactions and provide support. The language acquisition process is becoming more and more complex as it transcends the desktop and moves into a multi-layered process of language learning that is influenced by the intelligent agent, the emotional interactions and the context. Comprehending text continues to be the central element of this transformation, as a gateway to vocabulary, grammatical awareness, and critical thinking. However, with the advent of AI, the evaluation of a student's reading comprehension is no longer a one-way street, with the computer giving the student a test and the student then submitting his or her answer; it is a two-way street that includes the interaction between the learner, the adaptive system, and the pedagogical framework that guides the technology.

In recent years, the term "read" and "comprehend" has taken on new significance in digital environments, with the emergence of new technologies such as generative models like ChatGPT. These systems provide unprecedented opportunities to personalize and adapt content to a learner's individual level of proficiency,

cognitive needs, and sometimes mood. At the same time, there are significant technological challenges such as dependence of the learner, technostress and the ability of the machines to understand the complex socio-cultural context of human language. There is some scientific debate about whether AI can actually replicate biological and behavioural systems, but it doesn't have the same kind of human intelligence to grasp ambiguity and context-dependent communication. Therefore, it is crucial to use effective instructional design, like First Principles of Instruction (FPI) or Interactive Pedagogical Model of Language Learning (IPMLL), so that AI tools do not take the place of the student's effort.

In addition, the use of AI in the context of Mobile-Assisted Language Learning (MALL) enables learners to study on their own without relying on classroom teachers, which promotes learner autonomy. However, according to the studies, the platform is relevant; for example, Korean students who were preparing for TOEIC, demonstrated that AI CALL was superior to AI MALL in the reading test, most probably because of the problems of small screens and unstable networks in mobile devices. In this age, the use of AI cannot be seen as a novelty anymore, and its use should rather be seen as a socio-pedagogical agent. It demands a complete understanding of the impact of AI feedback, adaptive tutoring, and automated assessment tools on long-term retention of reading skills and the ability to apply these skills to real-world and non-digital settings.

Body of Research

The success of any ICALL environment is strongly related to the use of suitable reading instruction principles. Merrill's First Principles of Instruction (FPI) 4As and 1R (problem-centered, activation, demonstration, application, and integration) offer a solid structure in developing AI-supported reading tasks. AI can tap into a student's existing knowledge, for instance, by creating animated characters to ask definitions for unfamiliar words while they read. In addition, the demonstration principle is implemented when ICALL platforms are based on various communication means such as visual and audio support that can be adapted to the different learning styles. It is a common application in real time feedback systems where the learner has to apply his/her skills in the context of a text, for instance, in order to detect grammatical errors.

In addition to FPI, the Activity Theory (AT) provides a sociocultural approach to understanding learner-AI chatbot interactions. For an AT-based reading system, the "subject" is the student, the "object" is the reading comprehension task, and the "tools" are the AI agents that enable the learning process. This theory focuses on the fact that learning is not only a cognitive process on an individual level but also a process regulated by rules, communities and a division of labor between human and machine. Likewise, the task of the Interactive Pedagogical Model of Language Learning (IPMLL) is to combine the elements of CALL and AIALL in a single unit. This model combines the interactivity of traditional CALL with the adaptive and personalized feedback of AIALL, creating a more comprehensive and engaging learning experience that enhances the satisfaction and effectiveness of learners.

3. AI Technologies and Reading Comprehension Tasks Modern ICALL systems use a range of AI technologies to aid in reading comprehension, ranging from straightforward multiple-choice questions to semantically rich interactions. Natural Language Processing (NLP) makes it possible for machines to "understand" the student's input, thus generating factual questions that test the student's capacity to remember and recall information from any specific text. Intelligent Tutoring Systems (ITS) take this a step further by providing personalized instruction without human intervention. These systems can evaluate the learner's ability, identify the errors and provide activities specific to the learner's weaknesses in vocabulary or grammar.

The advent of Large Language Models (LLMs) such as GPT-3 and GPT-4 has taken computer-generated reading content to new heights, bringing a wave of optimism and promise.With the emergence of Large Language Models (LLMs) like GPT-3 and GPT-4, the quality of computer-generated reading content has reached new heights,

sparking optimism and promise. Studies have shown that while using LLM to create a reading passage and respective questions, the resulting content can be just as well suited to the desired level of proficiency as if written by a human, and in some instances even better. The VocaTT engine, for example, generates academic MCQ questions based on GPT-3.5, which, according to expert reviewers, the majority of sentences were well-structured. LLMs are also used in the Personalized Cloze Test Generation (PCGL) Framework to streamline the test writing process by producing both question stems and distractors from a single word, which also adapts the level of difficulty according to the learner's profile.

A key ability of AI in the era of ubiquitous computing is to deliver personalization on a large scale. The input is dynamically adjusted according to the responses of the students: ReadTheory and Tutor AI, for instance, adjust the text complexity based on student responses, implementing Krashen's $i+1$ hypothesis. Readlang and Tooltips.ai are designed for contextual vocabulary learning, enabling users to quickly translate words as they read. These are tools that support incidental learning, which is acquiring vocabulary from the text itself rather than rote memorized.

Moreover, with the help of corpora, data-driven learning (DDL) enables learners to explore patterns that occur in the natural language of the target language. This allows students to access authentic linguistic data, but lower proficiency learners need more scaffolding when using DDL than their higher proficient counterparts. While exposure to authentic text is essential to developing fluency and advanced comprehension, intermediate learners can easily be overwhelmed without the scaffolding that can be supported by AI.

The shift from Correct/Incorrect to Feedback and Assessment: Moving Beyond has gone from summative assessment at the end of the term to formative assessment through feedback in the age of AI. Computerized Dynamic Assessment (CDA) offers the learner an automatic mediation and enables the analysis of language related problems on the spot. Corrective feedback (CF) in these settings may be "graduated" such that it moves from general to specific hints and corrections. This strategy has proved to be effective in facilitating students to self-identify and self-correct in grammatical aspects in the process of reading and writing.

Automated Writing Evaluation (AWE) and Automatic Essay Scoring (AES) systems also are getting more sophisticated, evaluating semantic, discourse and pragmatics, as well as grammar and spelling. Write & Improve or Grammarly provides instant correction, urging students to revise regularly and often, without the pressure of a high-stakes final.Write & Improve and Grammarly allow immediate feedback, so that students are able to revise frequently and without great pressure of a final product. But automated feedback is far from perfect, and may give too many tips at once or be too general. While these drawbacks are real, the instant feedback from AI spurs additional revisions and refinements of text, a key component of written competence acquisition.

5. The Psychological and Behavioral Effect of Ubiquitous AI in Reading Instruction. Research conducted on the subject indicates that AI tools may help alleviate FLLA through their ability to allow students to make errors in a safe environment without fear of human evaluation. The study using ChatGPT showed that the use of ChatGPT as a learning aid decreased the demotivation and anxiety of the Saudi Arabian EFL learners and increased their autonomy. AI's adaptability to a learner's pace empowers them, fostering a sense of control in their learning.

The impact of AI isn't all positive, however. There are some learners who feel incompetent or "technostress" when confronted with autonomous agents. AI systems can help cultivate grit by offering structured goal setting and feedback, fostering passion and perseverance toward long-term goals. However, excessive use of these tools could interfere with the emotional connection that develops between the student and teacher and even contribute to cognitive passivity. Current AI systems still lack in their ability to communicate with people and genuinely feel their emotions, making it hard for students who need lots of social support.

6. Human Intelligence vs. AI: The Limits of the Machine: Although AI can process information in a much more rapid manner than the human brain, there is a fundamental difference between speed and quality of intelligence.

The human brain has complex cognitive elements that enable abstract thinking, forecasting long-term effects, and comprehending complex linguistic representations, which the machines still cannot. The ambiguity of human language and the contrast between context and meaning remain challenges for Natural Language Processing (NLP). AI models are based on binary algorithms (0s and 1s), which cannot fully capture the dynamic and context-sensitive nature of human communication.

These are revealed by the failures of AI tools like Siri or Alexa, especially when users have speech difficulties or use accents not in the user base. In a reading situation, AI might fail to identify semantically appropriate but not programmed responses, causing data failures with valid student input. This means that while AI can help in the learning process, it can't completely replace the need for human intervention, especially when it comes to explaining language in complex, nuanced ways or troubleshooting software malfunctions.

AI interventions in language learning are not gender neutral nor are they culturally neutral. Many of the AI models used are trained primarily on English corpora, and this can marginalize the learners of less commonly taught languages and the under-represented regions. Inclusive design of AI systems is an urgent need with the inclusion of localized corpora and dialectical variations to achieve linguistic equity. Additionally, digital inequities are significant, with learners in marginalized and rural areas often facing a lack of access to high-speed internet and sophisticated hardware to support advanced AI learning platforms.

Gender is also a factor in technology reception; studies have shown that boys tend to have more positive attitudes about the use of technology, this can have an impact on their involvement in CALL settings. But AI in CALL has also been demonstrated as a way to reduce substantial gender-based gaps in language learning scores and create a more equal opportunity field – if used properly. This implies that AI policies need to address these differences among learners and work towards ensuring that technology-based interventions benefit every student.

The pervasive use of AI necessitates a new concept of the teacher's role, from being the main source of knowledge to that of a facilitator, a co-educator. There is a lack of AI literacy among many teachers to effectively implement these tools, resulting in resistance or misapplication. Teacher professional learning is crucial for assessing, adjusting and co-creating AI-supported teaching. AI can handle administrative tasks like grading and tracking student progress, freeing up time for teachers to spend with their students.AI can automate administrative tasks, like grading and tracking student progress, allowing teachers more time to spend with their students.

Institutions need to re-consider curriculum design and assessment strategies also. Traditional assessment methods might not adequately capture the skills that students develop in AI-supported learning settings.The way AI-supported settings teach students skills may not be captured by traditional tests. AI helps in moving from a teacher-centred to a learner-centred approach, encouraging self-regulated learning. But it's a balance that must be struck, as technology should be used to augment knowledge, not supplant it.

With regard to the future of ICALL, it is likely that the next step will involve integrating the use of AI with immersive technology, such as Augmented Reality (AR) and Virtual Reality (VR). Linguistic information can be presented in an AR environment and the physical world can be combined (layered) to provide learners with a sense of interaction with a "linguistic landscape," thereby enlivening instruction more than traditional textbooks. AI-powered agents with an emotional face could further the humanization of the learning experience and enable more compassionate interactions.

The others being suggested include affective computing, which is based on the recognition of learner emotions. AI systems of the future could be capable of recognizing facial expressions and offering advice or assistance based on those expressions to help address individual emotional states and needs. This would solve today's "emotional gap" in AI – to make the tool more responsive to a learner's stress/fustration level. Last, ongoing investigation is needed to determine the longitudinal effects of AI on language retention, ensuring that the initial vocabulary acquisition or test scores will translate into real-world language proficiency.

Conclusion

The reading comprehension landscape has undergone a fundamental transformation with the rise of omnipresent artificial intelligence, and using the computer as the only tool to measure reading comprehension is now outdated. Building a robust pedagogical framework and understanding the technological constraints are essential for the effective integration of AI into educational practices, as it provides unprecedented tools for personalization, feedback, and engagement. With the right combination of AI and human expertise in language learning, these educators can create a learning environment that is more inclusive, equitable, and effective. In conclusion, the future of AI in language learning holds immense promise, but it will require further research and development to fully understand its potential and limitations.In summary, the future of AI in language learning is bright, but it will take time for researchers and educators to gain a more comprehensive understanding of its capabilities and potential challenges.

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