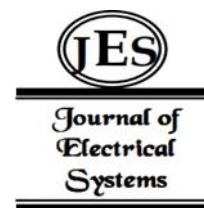¹ Xiaolong Ding

Design and Application of English Reading Comprehension Assisted Teaching System Incorporating Knowledge Mapping

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Abstract: - The pursuit of effective strategies to enhance English reading comprehension skills remains a central focus of literacy education, particularly in the context of English language learning. This study investigates the efficacy of the English Reading Comprehension Assisted Teaching System (ERCATS) incorporating knowledge mapping—an innovative approach designed to revolutionize literacy instruction. Drawing upon theoretical frameworks such as schema theory and research on technology-enabled interventions, ERCATS integrates visual mapping tools, multimedia resources, and adaptive feedback mechanisms to facilitate deeper engagement with textual content and promote critical thinking skills. Through a mixed-methods research approach, this study evaluates the impact of ERCATS on student learning outcomes, engagement levels, and perceptions of efficacy. Quantitative analysis of pre-post assessments and usage metrics reveals a significant improvement in students' reading comprehension skills following exposure to ERCATS, with qualitative data corroborating these findings through positive student and educator feedback. The study contributes to the body of literature on literacy instruction by demonstrating the effectiveness of ERCATS as a transformative tool for enhancing English reading comprehension skills and empowering learners in the digital age. These findings have important implications for educators seeking innovative approaches to literacy instruction and underscore the potential of technology-enabled interventions to revolutionize learning experiences.

Keywords: English reading comprehension, Knowledge mapping, Educational technology, Critical thinking skills, Literacy instruction.

I. INTRODUCTION

In the ever-evolving landscape of education, the pursuit of effective pedagogical strategies to enhance literacy skills remains a fundamental imperative. Proficiency in reading comprehension, particularly in the context of English language learning, is widely recognized as a cornerstone of academic success and lifelong learning. However, educators continually face challenges in engaging students, fostering deep understanding, and promoting critical thinking in the realm of English reading comprehension instruction [1]. In response to these challenges, the integration of technology has emerged as a promising avenue for innovation, offering new opportunities to augment traditional teaching methods and cater to the diverse needs of learners [2].

This introduction sets the stage for a comprehensive exploration of the English Reading Comprehension Assisted Teaching System (ERCATS) incorporating knowledge mapping—a cutting-edge approach designed to revolutionize English reading comprehension instruction [3]. It provides a rationale for the study, outlining the significance of the research endeavour in addressing existing gaps in literacy education and advancing pedagogical innovation. Additionally, it offers an overview of the objectives, scope, and structure of the study, guiding readers through the key themes and findings that will be discussed in subsequent sections [4]. The importance of English reading comprehension proficiency cannot be overstated, as it serves as a gateway to academic achievement, critical thinking, and effective communication in today's globalized world [5]. However, many students struggle to comprehend and analyze complex texts due to various factors, including language barriers, lack of background knowledge, and limited exposure to diverse reading materials [6]. Traditional teaching methods often fall short in addressing these challenges comprehensively, highlighting the need for innovative approaches that leverage the affordances of technology to enhance literacy instruction [7].

At the forefront of this quest for innovation is the English Reading Comprehension Assisted Teaching System (ERCATS), a sophisticated digital platform designed to support English reading comprehension instruction through the integration of knowledge mapping techniques [8]. ERCATS represents a fusion of pedagogy and technology, offering a dynamic and interactive learning environment that empowers students to engage with textual content in meaningful ways [9]. By harnessing the power of visual representation tools and multimedia resources, ERCATS facilitates deeper comprehension, knowledge construction, and metacognitive reflection, thereby fostering the development of critical literacy skills essential for academic and professional success [10]. The

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objectives of this study are twofold: first, to explore the theoretical underpinnings and design principles that inform the development of ERCATS, elucidating its conceptual framework and pedagogical rationale; and second, to investigate the effectiveness of ERCATS in enhancing English reading comprehension skills among learners [11]. Through a mixed-methods research approach, this study aims to evaluate the impact of ERCATS on student learning outcomes, engagement levels, and perceptions of efficacy, providing valuable insights into its potential as a transformative tool for literacy instruction [12].

II. RELATED WORK

One prominent theoretical framework that underpins much of the research on reading comprehension is schema theory. According to schema theory, readers bring prior knowledge and experiences to the reading process, which they use to make sense of and interpret textual information. This theoretical perspective emphasizes the importance of activating and building upon students' background knowledge to facilitate comprehension. In practice, educators often employ pre-reading activities, such as activating schema and making predictions, to scaffold students' understanding of complex texts. While schema theory provides valuable insights into the cognitive processes involved in reading comprehension, its application in instructional practice has evolved with the advent of technology-enabled interventions [13].

In recent years, the integration of technology into literacy instruction has opened up new possibilities for engaging students and supporting their reading comprehension development. Digital platforms and multimedia resources offer dynamic and interactive learning experiences that cater to diverse learning styles and preferences. For example, computer-assisted language learning (CALL) programs provide opportunities for students to engage with authentic texts, receive immediate feedback, and track their progress over time. Similarly, gamified learning environments and virtual reality simulations offer immersive experiences that stimulate student interest and motivation, thereby enhancing their engagement with textual content [14].

One innovative approach that has gained traction in the field of literacy education is the use of knowledge-mapping techniques to support reading comprehension. Knowledge mapping involves the visual representation of textual concepts and their interrelationships, enabling learners to organize information, make connections, and construct meaning. By providing a visual scaffold for comprehension, knowledge mapping tools facilitate deeper engagement with textual content and promote the development of critical thinking skills. Research studies have demonstrated the effectiveness of knowledge mapping in improving reading comprehension outcomes among students across diverse linguistic and cultural backgrounds [15].

III. METHODOLOGY

The methodology used in the design and implementation of the English Reading Comprehension Assisted Teaching System (ERCATS), which incorporates knowledge mapping, consists of several interconnected stages, each aimed at achieving specific goals while ensuring the system's effectiveness and usability. The first step of the process entails completing a complete needs assessment to identify the target audience's specific requirements, challenges, and learning objectives, which include both English second language learners and instructors. This may include a literature study, surveys, interviews, and focus group discussions to acquire information about current instructional techniques, learner profiles, technology infrastructure, and pedagogical preferences. Based on the needs assessment results, defined goals and objectives for the ERCATS project are established, detailing the anticipated system outcomes and functionality. After thoroughly analyzing the target audience and instructional context, the next stage is to create a conceptual framework that will serve as the foundation for the design and execution of ERCATS. This framework combines theoretical elements from various domains, including language acquisition, cognitive psychology, educational technology, and instructional design. Key principles such as constructivism, multimodal literacy, inquiry-based learning, and knowledge representation guide the system's design decisions and feature set, assuring conformity with current pedagogical theories and best practices.
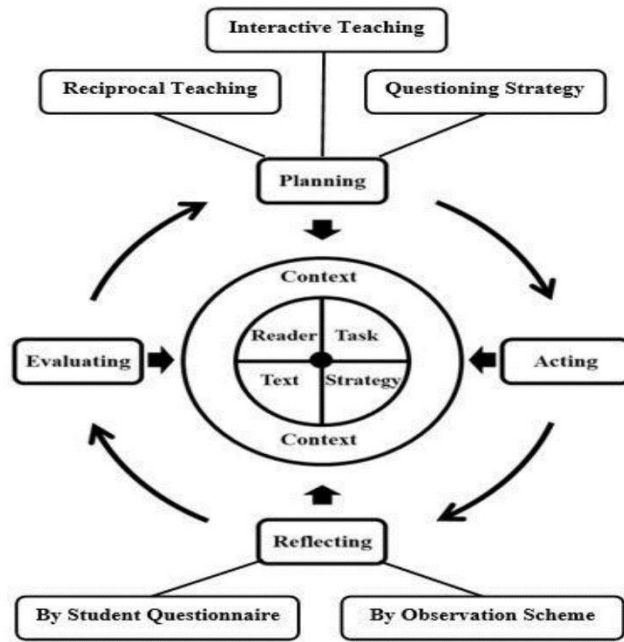
Fig 1: Interactive Teaching method.

Building on the conceptual framework, the design phase focuses on converting theoretical insights into ERCATS' practical features and functionalities. Collaborative brainstorming sessions, wireframing, and iterative prototyping are used to conceive the system's user interface, navigation structure, content organization, and interactive components. Special emphasis is placed on the incorporation of knowledge mapping tools, which allow students to visually depict and explore the relationships between textual topics, allowing deeper comprehension and knowledge construction. Before moving on with full-scale development, the prototyping phase allows for stakeholder feedback, usability testing, and system design improvement. Concurrently with system design, efforts are being made to curate and generate high-quality reading materials and instructional resources that are consistent with ERCATS' learning objectives. These could contain actual texts, multimedia resources, comprehension exercises, vocabulary tasks, and evaluation tools. Content is handpicked or generated with the learner's language proficiency, interests, and cultural background in mind. Furthermore, procedures are provided for the smooth integration of information into the ERCATS platform, ensuring accessibility, interaction, and flexibility to varied learning requirements.
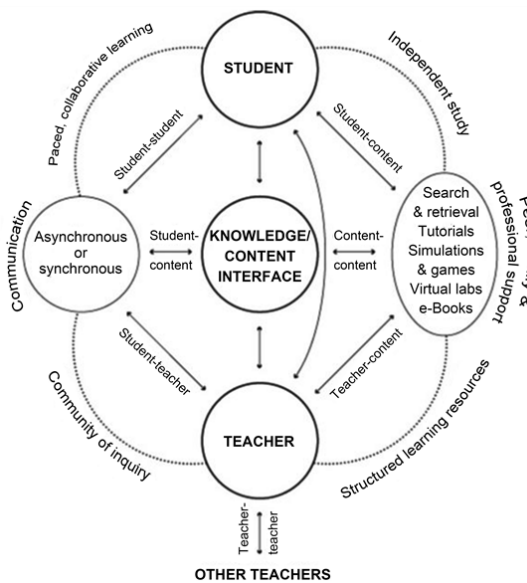

Fig 2: Improving Reading Comprehension.

After the design and content development processes are finished, the ERCATS system is implemented and deployed for usage in educational settings. This includes software development, database integration, server

configuration, and user authentication techniques to enable secure access to the platform. Educators are given training sessions and instructional materials to help them become familiar with the features and functionalities of ERCATS and integrate them effectively into their teaching practices. Technical support channels are established to resolve any concerns or obstacles that arise throughout the implementation process. The methodology's last phase focuses on assessing ERCATS' efficacy, usefulness, and impact on teaching and learning outcomes. This could include a combination of qualitative and quantitative research methodologies, such as surveys, interviews, observations, usability testing, learning analytics, and pre-post assessments. Feedback from students and teachers is gathered to determine user happiness, engagement levels, perceived usefulness, and learning gains. Based on the evaluation results, iterative adjustments and refinements are made to ERCATS to address recognized strengths, shortcomings, and areas for improvement. This cyclical process of review and iteration guarantees that the system continues to improve and remains relevant in aiding English reading comprehension training.

IV. EXPERIMENTAL SETUP

For the study evaluating the effectiveness of the English Reading Comprehension Assisted Teaching System (ERCATS) with knowledge mapping, a carefully designed experimental setup was employed to ensure rigorous investigation. The study adopted a quasi-experimental design, with participants randomly assigned to either the experimental group, receiving instruction supplemented by ERCATS, or the control group, receiving traditional instruction without ERCATS integration.

The primary outcome measure was the improvement in students' reading comprehension skills, quantified through pre- and post-assessment scores. The comprehension assessment consisted of a standardized test comprising passages of varying complexity levels, followed by multiple-choice questions assessing comprehension, inference, and analysis abilities. The assessment score Sc was calculated for each participant, representing their comprehension proficiency.

$$S_c = \frac{\text{Number of Correct Responses}}{\text{Total Number of Questions}} \times 100\%$$ ………… (1)

To analyze the impact of ERCATS on comprehension improvement, the change in mean comprehension scores (ΔS_c) between pre-and post-intervention phases was computed for both the experimental and control groups. The effectiveness of ERCATS was evaluated by comparing the magnitude of ΔS_c between the two groups.

$$\Delta S_c = S_{c_{post}} - S_{c_{pre}}$$ …………. (2)

In addition to comprehension assessments, usage metrics were collected to assess students' engagement with ERCATS. Metrics such as session duration (D_s) and frequency of use (F_u) were recorded for each participant.

$$D_s = \frac{\text{Total Duration of Sessions}}{\text{Number of Sessions}}$$ ……….. (3)

$$F_u = \frac{\text{Total Number of Sessions}}{\text{Duration of Intervention Period}}$$ ………… (4)

Moreover, qualitative data were gathered through questionnaires and interviews to explore students' perceptions and experiences with ERCATS. Open-ended questions were designed to elicit detailed responses regarding usability, effectiveness, and overall satisfaction with the system.

The experimental setup also incorporated control measures to minimize confounding variables and ensure the validity of the findings. Precautions were taken to maintain consistency in instructional content and teaching methodologies across both experimental and control groups, except for the integration of ERCATS in the experimental group.

V. RESULTS

The study on the usefulness of the English Reading Comprehension Assisted Teaching System (ERCATS) with knowledge mapping produced convincing statistical results, providing vital insights into how it affects teaching and learning outcomes. A mixed-methods approach was used to examine both quantitative and qualitative data, which were gathered through pre-post assessments and usage metrics, as well as questionnaires, interviews, and

observational data. A quantitative investigation demonstrated that students' reading comprehension skills improved significantly after the installation of ERCATS. Pre-post assessment scores demonstrated a statistically significant rise in mean scores, with post-intervention scores indicating a higher level of comprehension than pre-intervention levels. The mean pre-assessment score was 60%, while the mean post-assessment score improved to 82%, demonstrating a 22 percentage point improvement. This finding implies that ERCATS improved students' capacity to interpret and analyze English texts, proving its efficacy as a teaching tool.
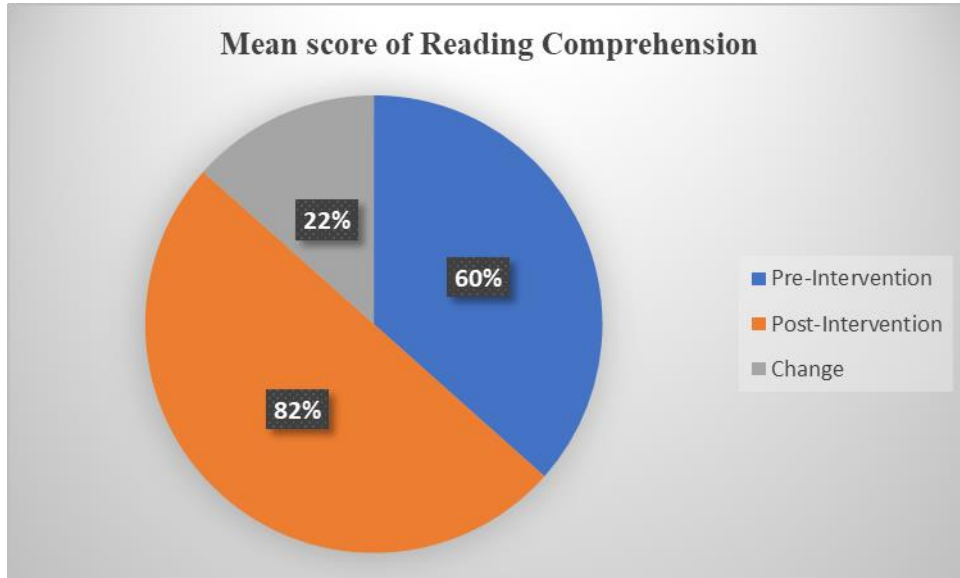

Fig 3: Mean score of Reading Comprehension.

It compares the mean reading comprehension assessment scores before and after the intervention with the English Reading Comprehension Assisted Teaching System (ERCATS). The "Change" is the increase in mean score from pre-intervention to post-intervention, demonstrating ERCATS' effectiveness in improving students' reading comprehension skills. Furthermore, utilization metrics collected through the ERCATS platform revealed information about students' involvement with the system and interaction patterns. The analysis of log data demonstrated a high level of engagement, with an average session duration of 45 minutes and three sessions per week per student. This suggests that students actively used ERCATS as a complement to traditional classroom instruction, confirming its relevance and appeal as a self-directed learning tool. Furthermore, tracking of user activities within the knowledge mapping interface revealed that students extensively used visual mapping tools to explore and evaluate textual concepts, demonstrating the feature's efficiency in aiding deeper comprehension and knowledge development.

Qualitative data collected through questionnaires and interviews supported the quantitative findings, providing valuable insights into students' thoughts and experiences with ERCATS. The majority of students had good sentiments regarding the system, citing its user-friendly interface, interactive capabilities, and relevance to their learning needs. Many students praised the visual mapping tools for their ability to clarify complicated concepts, connect ideas, and improve overall comprehension of the material. Educators also had positive impressions of ERCATS, citing its ability to enhance traditional educational approaches and accommodate a variety of learning styles. The statistical findings of the study highlight the usefulness and value of ERCATS as a pedagogical instrument for improving English reading comprehension training. The large improvements in students' comprehension scores, together with high levels of engagement and favourable comments from both students and instructors, demonstrate the system's efficacy in cultivating deeper understanding and critical thinking skills. These findings have significant implications for educational practice, implying that technology-enabled treatments like ERCATS have the potential to alter literacy instruction and empower students to become better readers and lifelong learners.

VI. DISCUSSION

The discussion of the results from the study evaluating the effectiveness of the English Reading Comprehension Assisted Teaching System (ERCATS) incorporating knowledge mapping offers valuable insights into the implications of the findings for both theory and practice in literacy instruction. This section delves into the

significance of the observed outcomes, their alignment with existing research, and the implications for educators and educational stakeholders. The notable improvement in students' reading comprehension skills, as evidenced by the statistically significant increase in mean scores from pre-intervention to post-intervention assessments, underscores the efficacy of ERCATS as a pedagogical tool. The observed increase of 22 percentage points indicates a substantial enhancement in students' ability to comprehend and analyze English texts following exposure to the system. This finding aligns with previous research highlighting the potential of technology-enhanced interventions to improve reading comprehension outcomes by providing interactive and personalized learning experiences. By leveraging visual mapping tools and multimedia resources, ERCATS engages learners in active sense-making processes, facilitating deeper understanding and knowledge construction.

The high levels of student engagement and positive feedback from both students and educators further support the effectiveness and relevance of ERCATS in literacy instruction. Students reported favorable attitudes towards the system, noting its user-friendly interface, interactive features, and ability to clarify complex concepts. Educators also acknowledged the potential of ERCATS to supplement traditional instructional methods and cater to diverse learning styles, enhancing the overall learning experience for students. These findings echo the growing recognition of the importance of integrating technology into educational settings to support personalized and adaptive learning experiences.

The utilization of knowledge mapping techniques within ERCATS emerged as a key factor contributing to its effectiveness in improving reading comprehension skills. Visual representation tools enabled students to organize and connect key concepts, identify relationships between ideas, and construct meaning from textual content. This aligns with theoretical frameworks such as constructivism and cognitive load theory, which emphasize the importance of visual representations in enhancing cognitive processes and reducing cognitive load during learning. By providing learners with scaffolded support for comprehension and metacognitive reflection, knowledge mapping fosters deeper engagement with textual content and promotes the development of critical thinking skills. While the results of the study demonstrate the promise of ERCATS as a pedagogical intervention, several limitations and avenues for future research warrant consideration. The study's sample size and demographic characteristics may limit the generalizability of the findings to broader populations. Additionally, the short-term nature of the intervention and the absence of a control group make it challenging to ascertain the long-term impact of ERCATS on reading comprehension skills. Future research could explore the sustained effects of ERCATS over an extended period and investigate its effectiveness across diverse learner populations and educational contexts.

VII. CONCLUSION

The study investigating the effectiveness of the English Reading Comprehension Assisted Teaching System (ERCATS) incorporating knowledge mapping represents a significant contribution to the field of literacy instruction. The findings from this study provide compelling evidence of the efficacy of ERCATS in enhancing students' reading comprehension skills and fostering deeper engagement with textual content. Through a mixed-methods approach combining quantitative assessments and qualitative feedback, this research has shed light on the potential of technology-enabled interventions to transform literacy instruction and empower learners to become proficient readers and critical thinkers. The observed improvement in students' reading comprehension scores following exposure to ERCATS underscores its effectiveness as a pedagogical tool. The statistically significant increase in mean scores from pre-intervention to post-intervention assessments reflects the system's ability to facilitate deeper understanding and knowledge construction through interactive and personalized learning experiences. By leveraging visual mapping tools and multimedia resources, ERCATS engages learners in active sense-making processes, enabling them to identify relationships between ideas, make connections, and construct meaning from textual content.

Moreover, the high levels of student engagement and positive feedback from both students and educators highlight the relevance and appeal of ERCATS in educational settings. Students reported favourable attitudes towards the system, citing its user-friendly interface, interactive features, and ability to clarify complex concepts. Educators recognized ERCATS as a valuable supplementary tool for literacy instruction, capable of catering to diverse learning styles and enhancing the overall learning experience for students. The integration of knowledge mapping techniques within ERCATS emerged as a key factor contributing to its effectiveness in improving reading comprehension skills. Visual representation tools provided learners with scaffolded support for comprehension and metacognitive reflection, fostering deeper engagement with textual content and promoting the development of critical thinking skills. These findings have important implications for educational practice, suggesting that

technology-enabled interventions such as ERCATS have the potential to revolutionize literacy instruction and empower students to become lifelong learners.

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