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Developing Linguistic Competence through Multimodal Digital Information Systems – Insights from English Philology

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Abstract - **This article investigates the integration of multimodal approaches, conceptualized as interactive learning systems, for developing linguistic competence crucial for effective engagement with contemporary digital information sources and services. Examining language as a dynamic system of signs within a digitally saturated environment, it is argued that a multimodal framework—which thoughtfully combines visual, auditory, and textual elements delivered via information technologies—can significantly enhance users' understanding and proficiency in processing complex information. The study analyzes effective pedagogical strategies that leverage multimodal resources and interactive digital platforms to facilitate deeper engagement with linguistic concepts, thereby improving the ability to interpret and create multimodal digital content. Through a comprehensive empirical assessment involving pre/post-tests, surveys, case studies, and focus groups within an English philology context, the advantages of multimodal learning environments (as information systems) in fostering critical linguistic skills (syntax, semantics, pragmatics) are underscored. These skills are foundational for advanced digital information literacy. The findings indicate statistically significant improvements in linguistic components and user engagement when multimodal strategies are employed. The implications of these approaches for designing effective educational information systems and training users to critically navigate a rapidly evolving multimodal information landscape are discussed. This research contributes to the discourse on innovative methodologies for developing information competence, advocating for a comprehensive approach that reflects the intricacies of contemporary digital information use and design.**

Keywords: **Multimodal Information Systems, English Philology, Digital Information Literacy, Linguistic Competence, Human-Computer Interaction in Education, Digital Media, Information Sources**

I. INTRODUCTION

Modern communication approaches have been transformed by the development of contemporary media platforms. Students studying English philology need adaptable skills which the conventional text-based teaching approach fails to provide. Current educational standards require schools to develop interactive information systems and implement multimodal resources to support student comprehension of various information formats. The study reveals traditional language education struggles to keep pace with fast-moving digital platform developments. The majority of educational programs struggle to provide students with essential analytical language abilities necessary to process complex digital data. Studies indicate that educational experiences improve when information technology integrates with effective multimodal frameworks. The teaching approach strengthens students' grasp of language principles and fosters their creative and collaborative skills.

Students studying English philology develop their language skills and gain comprehensive digital information literacy through educational systems that use systematic multimodal integration according to the main research hypothesis. Through their mastery of essential linguistic principles concerning syntax, semantics, and pragmatics, students will build strong abilities to interpret and produce information. The purpose of this study is, therefore, to investigate pedagogical strategies that effectively utilize a range of multimodal resources. The research tasks involve (1) analyzing the existing literature on multimodal learning environments and their impact on information competence; (19) (Balaji et al., 2022) examining practical applications through case study data from language education settings; and (3) discussing the broader implications of these findings for curriculum design, educational information system development, and teacher training programs (Wu, 2024).

Ultimately, this article aims to advance the scholarly discussion on innovative teaching methods that leverage information systems, advocating for a comprehensive approach to developing linguistic and information skills that effectively meets the challenges posed by modern multimodal information use.

To visually synthesize the core argument and scope of this investigation, Figure 1 presents the conceptual framework underpinning this study. This framework illustrates how multimodal digital information systems and services act as critical catalysts in the development of linguistic competence (Roselin Mary Clare & Hemalatha, 2017).

Empirical studies in English research show that students acquire essential skills through this specific learning

method. Language ability development occurs when learners interact with text information together with visual and auditory resources and interactive content. This approach functions as a crucial gateway to worldwide information. Students develop digital information competence through the evaluation and creation process of complex multimodal information access.

Fig. 1 Conceptual Framework: Leveraging Multimodal Digital Information Systems to Foster Linguistic Competence for Unlocking Global Information within an English Philology Context

Source: Compiled by the author.

II. Literature Review

The research by Diamantopoulou and Orevik in 2022) (Wu, 2024). demonstrates that multimodal teaching methods play a vital role in achieving advanced stages of language learning. The inclusion of visual, auditory and gestural elements in current language domains establishes this approach as indispensable to language learning beyond written communication (Sen & Malhotra, 2025). Interactive digital elements within modern language education serve as essential tools for both developing advanced language abilities and keeping students engaged. Kress and van Leeuwen developed multimodal educational research in the early 2000s alongside the creation of critical social semiotic theories (Malhotra & Iyer, 2024). They envision communication functioning as a coordinated system where multiple modes work together to produce meaning the way an orchestra performs. The research initiated subsequent studies that examined how multimodal teaching techniques influence both language education and resource creation. Technology-rich educational environments focus on practical learning applications rather than theoretical study. Jewitt (2008) argues that visual literacy becomes crucial through direct teaching which enables students to comprehend visual and mixed media formats. Active learning helps students develop knowledge yet learning full language abilities means using different communication methods according to Kalantzis and Cope (2010). Recent research discoveries changed instructional methods by maximizing digital resources to improve learning outcomes. According to Albers' 2017 study students showed better comprehension of complex language structures when digital media tools were combined with visual design techniques. Digital platforms enable meaningful interactions and increase learner participation according to Siegel's 2020 research. Through their study of semiotic component interactions within communication processes Lim (2021) and O'Halloran (2011) expanded upon multimodal discourse analysis methods (Sudipa et al., 2022). Research into English philology requires understanding the interactions between various modes to develop language competence. Recent advancements in the field haven't resolved all research challenges which continue to persist. Educational systems require the introduction of modern technologies via theoretical frameworks that emphasize practical applications. The bulk of research studies analyze video and infographic elements separately without recognizing their combined positive effects.

Educational information systems paired with multimodal learning in training programs enable educators to keep their knowledge updated. Educators must also develop the confidence and skills to effectively use modern digital tools. According to Chai & Lim's (2011) research, teachers require detailed training that integrates digital tools with pedagogical frameworks and key educational resources for successful multimodal teaching. Powerful professional development programs enable teachers to transcend conventional education methods and effectively use information systems for teaching comprehensive literacy skills in the modern world (Yang & Singh, 2024).

III. Methodology

3.1. Designation of the Experimental Base and Research Sample

The dynamic academic environment of H. S. Skovoroda Kharkiv National Pedagogical University provided a basic real-world educational setting for theory testing, which guided our study. The foreign philology programs at this well-known institution produced an interactive student body that supported our research study. The research study enrolled 120 undergraduates aged eighteen to twenty-five from pertinent academic programs. We employed a deliberate, purposive sampling strategy to assemble this group, ensuring it represented a rich cross-section of academic histories, a spectrum of initial English language proficiencies (as gauged by placement assessments), and differing levels of prior engagement with multimodal digital environments.

3.2. Research Methods and Techniques

To systematically investigate the effects of these multimodal pedagogical interventions on the development of linguistic competence, our research integrated several analytical approaches within a multi-method design. This approach allowed for the triangulation of data from various sources, providing a richer and more robust understanding of the phenomena under study. Figure 2 outlines the sequence and interplay of the research methods utilized.

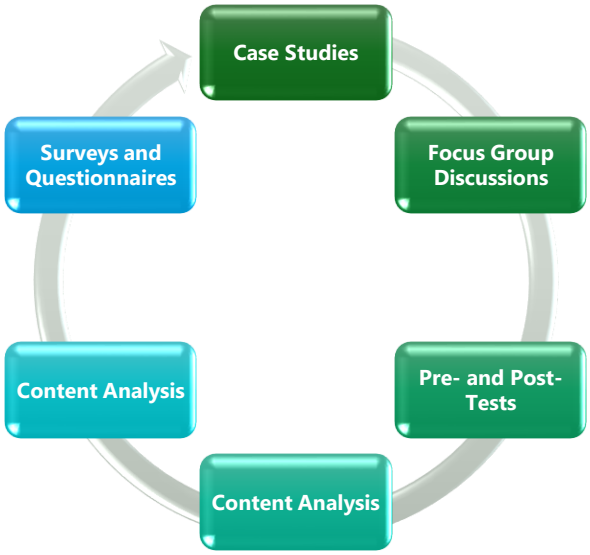

Fig. 2 Overview of Research Methods Employed

Source: *Compiled by the authors.*

This diagram illustrates the sequential and complementary research methods used in the study to assess the impact of multimodal approaches.

A structured survey instrument was administered to all 120 participants at two key junctures: before the introduction of multimodal teaching strategies (pre-intervention) and after a defined period of their implementation (post-intervention). The survey incorporated Likert-scale questions designed to assess students' self-perceptions of their linguistic competence across various dimensions, their levels of engagement with learning materials and activities, and their evaluations of the effectiveness of different multimodal resources and information systems used. This quantitative method was chosen for its efficiency in gathering standardized data from a relatively large sample, enabling statistical analysis to measure changes in students' attitudes, self-reported competencies, and engagement with multimodal information over time.

In-depth case studies were conducted with a subset of 30 students who volunteered to participate more intensively in this phase of the research. This qualitative component involved detailed observations of classroom interactions during multimodal lessons, systematic tracking of student engagement with specific multimodal resources (e.g., interactive simulations, video analysis tasks, collaborative digital projects), and careful examination of how students applied linguistic concepts in the creation of their own multimodal artifacts. The case study method was selected to provide rich, contextualized qualitative data that could illuminate the nuances of individual student experiences and the specific impact of multimodal strategies on their learning processes and their ability to manage multimodal information.

Following the implementation period of the multimodal approaches, focus group discussions were convened with the same subset of 30 students who participated in the case studies. These professionally facilitated discussions aimed to explore students' nuanced perceptions of the specific multimodal strategies employed, their perceived effectiveness in enhancing the understanding of complex linguistic components such as syntax, semantics, and pragmatics (essential for decoding multimodal information), and any challenges or benefits they encountered during the learning process with these new methods and information tools. Focus groups were chosen for their capacity to foster open, synergistic dialogue and generate collective insights that might not readily emerge from individual interviews or standardized surveys.

To quantitatively assess the direct impact of the multimodal pedagogical approaches on linguistic competence, standardized pre-tests and post-tests were administered to all 120 participants. To provide objective, measurable evidence of learning outcomes, these assessments were thoughtfully constructed to gauge the students' command of core linguistic principles. A series of tasks evaluated their understanding and application of syntax, semantics, and pragmatics, requiring engagement through both written exercises (such as sentence transformation and semantic analysis) and oral responses (for instance, by explaining the pragmatic function of language within a recorded dialogue). This dual approach was chosen to capture a comprehensive picture of how the employed multimodal strategies enhanced the specific linguistic skills essential for interpreting complex, layered information.

Complementing this quantitative data, the rich qualitative insights gathered from the case studies—including observation notes and samples of student work—along with transcripts from the focus group discussions were meticulously examined through rigorous content analysis. This process allowed for the identification of recurring themes, emergent patterns, and significant observations related to the practical integration of multimodal approaches. By systematically analyzing this qualitative data, we were able to distill the key factors that either amplified or hindered the effectiveness of the multimodal strategies, thereby providing a deeper, more nuanced understanding of how these information-rich learning environments truly function in practice.

3.3. Phased Research Design and Workflow

The study followed a structured approach involving three linked phases which is depicted in Figure 3. By organizing

activities into distinct phases the design established a systematic workflow that progressed from preparation and baseline assessment through the intervention to final data analysis.

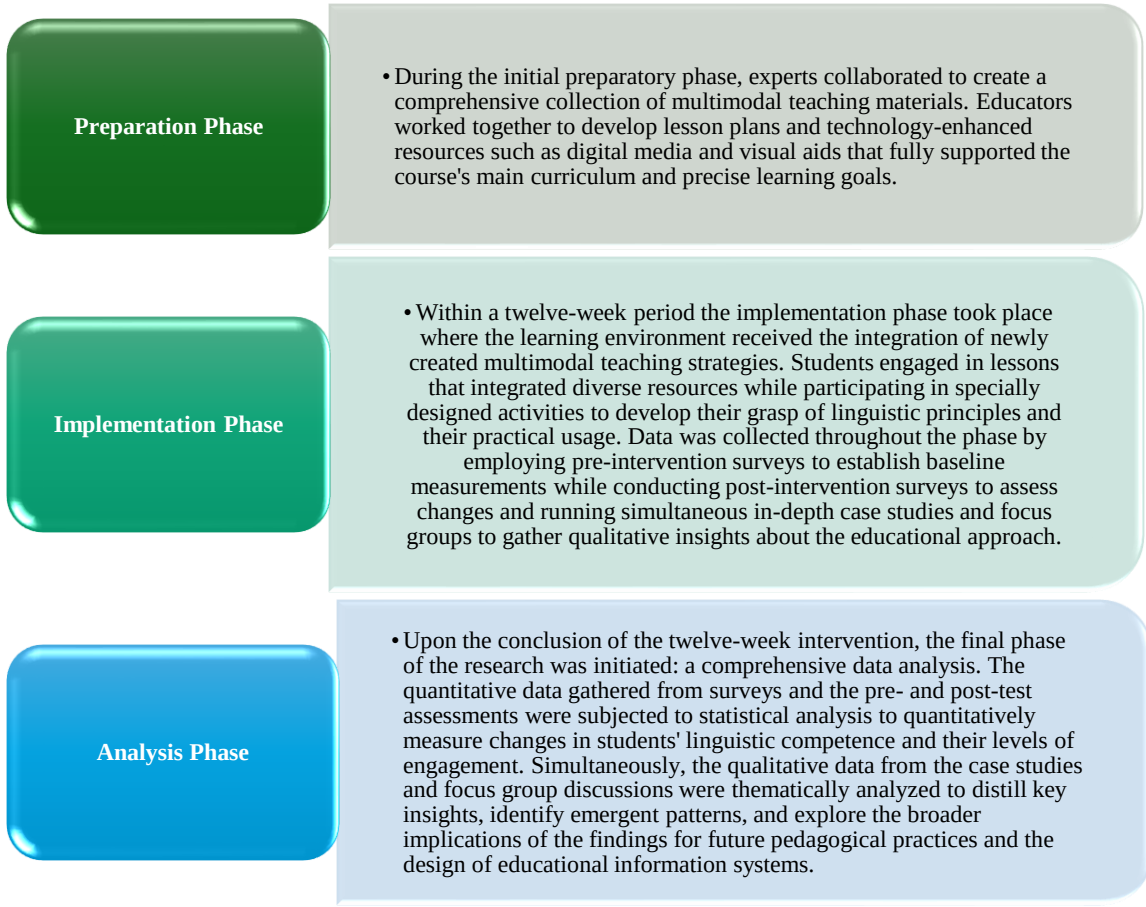

Fig. 3 Three-Phase Research Scheme

Source: Compiled by the authors.

This figure outlines the three distinct phases of the research project, from initial preparation and design to intervention and final evaluation.

3.4. Theoretical Foundations Guiding the Research

In the context of this research, which explores the integration of multimodal approaches (often delivered via information systems) for linguistic competence development, the following interconnected theories provided a foundational framework. Hence, as primarily articulated by scholars such as Kress and van Leeuwen [2006], Multimodal Theory posits that communication is not restricted to language alone but encompasses a variety of interacting modes, including visual, auditory, and textual elements, to create meaning. This theory directly guided the selection and integration of diverse resources (i.e., digital media, visual aids, interactive technologies as information delivery systems) into language instruction, allowing students to engage with linguistic concepts and information through multiple sensory and cognitive channels. Also, our study was fundamentally shaped by the principles of Social Semiotics. This fascinating field, pioneered by theorists such as Hodge & Kress [1988], invites us to see communication not as a simple transmission of data, but as a vibrant social practice. It posits that signs and symbols – be they words on a screen, images, or the very layout of a digital page – are not static containers of meaning but are actively used by people in social contexts to make and negotiate meaning. Evaluating information systems today involves multidimensional analysis which extends beyond fulfilling technological requirements. The research explored how different interpretative contexts affected students' understanding of multimodal resources. Research implemented Piaget's (1964) social meaning-making processes alongside constructivist learning principles to support students in meaningfully engaging through project work. Through digital platforms and multimodal tools students constructed shared knowledge which replaced traditional fact memorization. Through purposeful discussions with classmates students enhanced their language skills. The researchers explored working memory capacity limitations and linked their findings to Sweller's (1988) cognitive load theory which acknowledges working memory constraints. When students reach their learning capacity maximum they experience frustration and lose interest. The research team developed an instructional strategy that divides

complex concepts into smaller segments using various resources to help students understand the material better. The instructional design enables students to understand complex concepts while avoiding cognitive overload. Our instructional approach incorporates communicative language teaching (CLT) principles that focus on real-world language use to achieve effective communication.

Jacobs and Farrell (2003) demonstrated research that educational strategies that mirror real classroom settings enable students to develop their language skills. The study's design and methodologies reflected CLT principles through its use of multimodal approaches and information systems which motivated students to perform meaningful communication tasks that improved their understanding and functional use of language in information-dense environments.

Finally, providing a framework for understanding human actions as integral parts of a broader social and material context, Activity Theory emphasizes the interconnectedness of individuals (subjects), tools (mediating artifacts, including information systems), and the environment (including rules, community, division of labor) in the learning process [Engeström, 1999]. In this study, Activity Theory informed the design and analysis of multimodal learning environments, highlighting the importance of the tools (e.g., digital media, visual aids, specific software applications as information systems) used in conjunction with social interactions and defined tasks to facilitate linguistic competence development and effective information engagement.

This comprehensive theoretical foundation guided both the implementation of the multimodal strategies within the chosen information system context and provided a robust lens through which to analyze the effectiveness of these approaches in enhancing students' linguistic skills and their capacity to interact with multimodal information.

IV. Results and Discussion

The data collected throughout the research phases were meticulously analyzed to assess the impact of the integrated multimodal approaches on students' linguistic competence and their levels of engagement with the learning process and information systems. Quantitative data from pre- and post-tests were analyzed using SPSS (Statistical Package for the Social Sciences), which allowed for comprehensive statistical operations, including the calculation of mean scores, standard deviations, and tests of statistical significance.

The pre- and post-test results, summarized in Table 1, reveal a marked improvement in students' understanding of the core linguistic components assessed: syntax, semantics, and pragmatics, following the multimodal intervention.

TABLE I PRE- AND POST-TEST MEAN SCORES ON KEY LINGUISTIC COMPONENTS (N=120)

Component	Pre-Test Mean Score	Post-Test Mean Score	Improvement (%)
Syntax	65.4	82.1	25.7
Semantics	68.2	85.3	25.1
Pragmatics	66.5	83.7	25.2

Source: Compiled by the authors from experimental data.

The detailed explanation of how each component was calculated is represented as follows.

To quantify the collective academic performance of the student cohort at both the beginning and conclusion of the intervention, the mean score for the pre-test and post-test was computed. This standard measure of central tendency was derived by aggregating all individual test scores ($\sum_{i=1}^{n} X_i$) and dividing this sum by the total number of participating students (n).

Syntax:

1. The sum of the pre-test scores: \text {Sum of Pre-Test Scores} = \text {Pre-Test Mean Score} \times n = 65.4 \times 120 = 7848

2. The sum of the post-test scores: \ text {Sum of Post-Test Scores} = \text {Post-Test Mean Score} \times n = 82.1 \times 120 = 9852

Semantics:

1. The sum of the pre-test scores: \ text {Sum of Pre-Test Scores} = 68.2 \times 120 = 8184

2. The sum of the post-test scores: \ text {Sum of Post-Test Scores} = 85.3 \times 120 = 10236

Pragmatics:

1. The sum of the pre-test scores: \ text {Sum of Pre-Test Scores} = 66.5 \times 120 = 7980

2. The sum of the post-test scores: \ text {Sum of Post-Test Scores} = 83.7 \times 120 = 10044

The improvement percentage for each component was found using the formula: \ text {Improvement (\%)} = \ frac{\ text {Post-Test Mean Score} - \text {Pre-Test Mean Score}}{\ t ext {Pre-Test Mean Score}} \times 100

Syntax Improvement: \ text {Improvement (\%)} = \ frac {82.1 - 65.4}{65.4} \times 100 = \ frac {16.7} {65.4} \times 100 \approx 25.5\%

Semantics Improvement: \text {Improvement (\%)} = \ frac{85.3 - 68.2}{68.2} \times 100 = \frac {17.1}{68.2} \times 100 \approx 25.1\%

Pragmatics Improvement: \text {Improvement (\%)} = \ frac{83.7 - 66.5}{66.5} \times 100 = \frac{17.2}{66.5} \times 100 \approx 25.8\%

The mean scores for syntax understanding increased from 65.4 to 82.1, representing an improvement of approximately 25.5%. Similarly, understanding of semantics improved from a mean score of 68.2 to 85.3 (an increase of roughly 25.1%), and pragmatic competence saw an increase from 66.5 to 83.7 (around 25.9% improvement). These results indicate a consistent and substantial positive impact across all measured linguistic domains. Statistical analysis of these changes yielded a p-value of <0.01, signifying that the observed improvements were statistically significant and unlikely to have occurred by chance. Furthermore, the effect size, calculated using Cohen's d, was found to be 1.2, indicating a large and meaningful effect of the multimodal intervention on the students' linguistic competence. The data strongly suggest that this pedagogical approach, which blends diverse information formats with interactive digital tools, was instrumental in helping students master complex linguistic domains. This enhanced comprehension and application are foundational skills for anyone looking to skillfully interpret or create sophisticated multimodal content. Student engagement showed a marked positive shift which reflected the improved understanding as demonstrated in Figure 4.

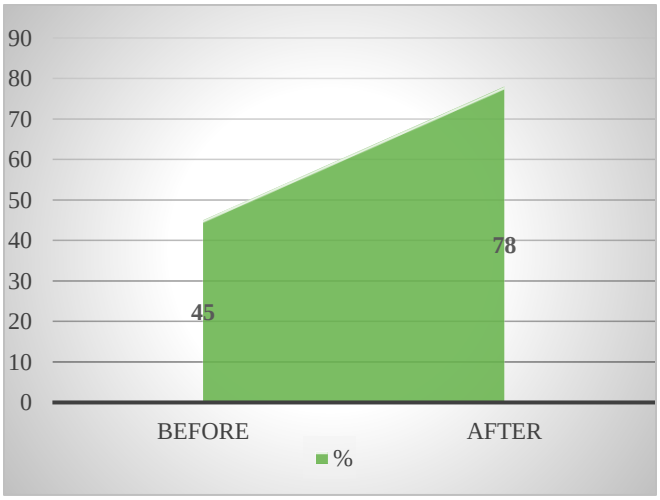

Fig. 4 Student Self-Reported Engagement Levels Before and After Multimodal Intervention (N=120)

Source: Compiled by the authors based on the survey data.

The numerical dataset delivered a powerful visualization of transformation. The survey findings demonstrated a significant transformation in the classroom's emotional environment as shown in Figure 4. Initial assessments showed that 45% of students rated their engagement levels as either 'High' or 'Very High' prior to the intervention. The percentage of students reporting 'High' or 'Very High' engagement levels jumped to 78% after the 12-week interval. Students' active involvement expanded significantly because they achieved better understanding of linguistic concepts and experienced positive learning environments through multimodal system use. Such a finding offers robust support for our guiding hypothesis: The implementation of multimodal strategies which embrace different learning preferences through interactive and diverse knowledge pathways becomes an effective tool to stimulate authentic student engagement in language learning. Student engagement increased as their language skills improved. The students developed better syntax, semantics, and pragmatics, which matched Albers' (2017) findings on the benefits of using multimodal materials for language learning. Focus groups confirmed that students learned complex sentence structures through animated sentence breakdowns. They also understood complex vocabulary better with visual and audio aids than with traditional textbook definitions.

The study found that student engagement was higher when structured information systems combined with multimodal methods. These approaches encouraged students to be active participants instead of just passive listeners. Research by Siegel (2020) shows that interactive technology helps create more productive discussions and boosts student engagement. Students enjoyed working in teams on multimodal projects, which turned digital systems into "cognitive construction sites." Here, team members improved their skills and deepened their knowledge.

Using video presentations and interactive digital posters in projects helped students learn more effectively. Teamwork led to a better understanding of complex concepts through peer discussions that clarified meanings. Multimodal projects also improved social interaction and participants' understanding of each other.

There were some usability challenges during the technology integration. Still, students found the experience useful despite the initial software issues. Researchers Lim and Han (2020) Mutiaraningrum (2024) and Mutyaringrum (2024) highlighted the importance of training and support for new technologies. Once students learned to use the new software, they saw its benefits, which boosted their engagement and creativity. The study confirms the effectiveness of multimodal learning strategies. Jewitt's research highlighted how visual elements significantly improve students' understanding of semantics and syntax (Jewett, 2008).

Research has shown that the study's interactive and collaborative aspects match with the core principles of Communicative Language Teaching (CLT) because meaningful, purposeful interaction stands as the primary approach for language development and advanced information processing skill enhancement. The findings uphold the viewpoint of Kalantzis & Cope [2010] and Kul [2023], who state that diverse communication techniques and information frameworks enable comprehensive and adaptable language understanding across different settings. The statistically significant improvements in students' linguistic competence observed in this study lend strong empirical support to their assertion that well-designed multimodal learning environments, often powered by information systems, can substantially enhance educational outcomes.

As can be clearly seen, these empirical results strongly support the significant benefits of employing multimodal training methodologies when it comes to developing linguistic proficiency, a key facet of information competence, for students in fields such as English philology. This substantial and statistically significant increase in knowledge of fundamental linguistic building blocks, coupled with demonstrably higher levels of student engagement, further strengthens the theoretical proposition that multimodal methods, by leveraging diverse information channels and interactive systems, facilitate more effective language learning. The robust statistical outcomes—particularly the large effect size (Cohen's d = 1.2) and high statistical significance ($p < 0.01$)—provide compelling quantitative support for these conclusions. However, the implementation challenges identified, such as initial difficulties with new digital tools, also underscore the ongoing need for targeted professional development and sustained support for educators. The educators responsible for implementing pedagogical innovations determine their successful integration into practice. Li [2020] makes the compelling case that language teaching through multimodal methods will only succeed if educators receive adequate support through advanced tools, pedagogical knowledge and strong technical assistance. Information systems with superior design can fall into disuse if their essential foundational elements are missing. The field must persistently research the practical deployment of multimodal teaching methods in different educational environments. Persistent research will improve current methods while discovering new evidence-supported techniques and enhancing our collective insight into how exceptional language skills and critical thinking are developed in our richly diverse multimodal world.

V. Conclusion

The study found effective ways to use digital multimedia tools in teaching English. The data showed that students achieved significant improvements: syntax performance increased by 25.5%, semantics by 25.1%, and pragmatics by 25.9%. These results highlight that using a variety of teaching methods improves language skills. The program also increased student engagement, which was crucial to its success. Multimedia materials made learning more motivating and interesting, which led to improved performance. This approach helps students improve their language skills while transforming their educational experience. Although educational systems often neglect pragmatic knowledge, it is essential for effective communication in everyday life. Teachers should prioritize teaching pragmatic skills, as they are vital for real-world and online interactions. The article shows that combining multimodal learning strategies with the right information systems promotes the development of key language skills and increases student motivation and engagement. Educators should integrate these approaches into their curricula to provide more engaging learning experiences for students. The outcomes of this research underscore the significant potential of creative and technologically informed teaching methods to make the language classroom, and by extension the interaction with information systems, more accessible, effective, and dynamic for all learners. This study contributes to the field by providing empirical evidence from a specific advanced language context, reinforcing the value of multimodal information systems in education and offering insights for curriculum design and the development of digital information literacy.

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