Leveraging Instructional Multimodality for Enhanced English Grammar Learning of Undergraduate Students: A Higher Education Perspective

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***Abstract*—This research sought to investigate the influence of instructional multimodality on grammar acquisition by exploring students' engagement with diverse learning modalities, both in and out of the classroom settings. A structured questionnaire comprising 42 Likert-scale items was administered to 212 students enrolled in English language and literature education at a state university in West Sumatra. Descriptive statistics were utilized to analyze responses concerning their perceptions of multimodal learning aids, including books, multimedia, software, and various digital contents like images, audio, text, social media, websites, and applications within a quantitative framework. The results demonstrated that students showed positive reactions to multimodal learning tools, especially multimedia and software. These resources effectively engage students and improve their understanding of grammar. Non-verbal elements, such as imagery and auditory tasks, markedly improved memory retention and grammatical comprehension. Social media and mobile applications contribute to participatory learning and offer immediate feedback. This research illustrates those multimodal strategies support students' motivation, address diverse preferences, and assist grammar learning. The study emphasizes that enhancing the dynamism and efficacy of grammar instruction requires educators to incorporate multiple learning modalities. Future research may examine the enduring effects of multimodal learning on grammatical proficiency and its application in various linguistic contexts.**

***Keywords*—multimodality, instructional multimodality, English grammar, grammar learning, learning materials**

I. Introduction

Grammar proficiency is a fundamental aspect of English language mastery, essential for effective communication and structured expression. A comprehensive grasp of grammar enables learners to analyze and formulate logical connections within language, thereby improving their capacity to express structured ideas and opinions clearly [1]. This fundamental skill enhances language proficiency and provides students with the necessary resources for accurate expression, thereby supporting academic achievement and communicative effectiveness. While the significance of grammar is acknowledged, traditional grammar instruction is frequently criticized for its reliance on rote learning, which can disengage students and hinder a deeper understanding of language.

Advancements in digital technology have led to the integration of multimodal resources, resulting in a paradigm shift in educational practices, including grammar instruction [2]. Modern e-learning platforms enhance grammar instruction by incorporating a variety of online resources, contrasting with traditional methods that typically depend on repetitive exercises and memorization, thereby creating an interactive and media-rich learning experience [3]. This multimodal approach transcends passive learning by offering students opportunities to engage with dynamic inputs, including video, audio, and interactive activities, which enhances their comprehension of language use in context [4–6]. While promising, these approaches may lead to superficial learning if not properly balanced, as an overreliance on multimedia could distract from the critical analytical skills necessary for understanding complex grammatical structures [7].

Hybrid instructional methods that integrate offline and online resources with diverse multimodal content demonstrate the value of multimodal-based learning in enhancing meaning-making during language acquisition [8]. Multimodal approaches enhance the interpretive and communicative dimensions of learning by integrating visual, gestural, spatial, and linguistic cues. This integration provides learners with diverse modalities for understanding grammar in a contextualized and intuitive manner [9]. Multimodal input is associated with increased motivation and a greater willingness among learners to engage in language experimentation, promoting an experiential approach to mastery [10]. However, these methods possess inherent limitations. Critics contend that an excessive emphasis on visual or auditory components in multimodal instruction can obscure fundamental language mechanics and structure, particularly for novice learners who might feel overwhelmed by the concurrent processing of various modes [11, 12].

Grammar presents a significant challenge for both educators and learners in terms of instruction and acquisition. The anxieties linked to grammar learning are heightened by several language-related challenges, such as the difficulties in applying rules during real-time communication [13, 14]. Given these challenges, investigating pedagogical strategies that utilize multimodal learning may offer effective solutions. Multimodal instruction has the potential to address students' varied learning preferences, which may enhance engagement and reduce the anxiety typically associated with grammar acquisition. Nonetheless, it poses a risk of distraction, especially for novices, who might perceive the multitude of sensory inputs as overwhelming and possibly detrimental to

their learning process.

Multimodal learning approaches are acknowledged for their effectiveness in improving literacy and language development in various educational contexts [15, 16]. Multimodality in English language education has been demonstrated to enhance learner motivation, engagement, and language proficiency [9, 17–19]. Multimodal instruction can promote self-directed learning and enhance learners' comprehension of grammatical structures, as demonstrated by Lee and Revesz [20]. Their research indicated that the integration of multiple modalities enhances comprehension and retention of grammar rules, underscoring the instructional significance of multimodal approaches.

Subsequent research has examined students' perceptions and classroom implementations of multimodal learning, highlighting its beneficial impacts on engagement and language acquisition [21–25]. These investigations primarily concentrate on classroom settings, resulting in a significant gap in the comprehension of multimodal learning outside the classroom, especially in digital and media-rich contexts. Considering the swift emergence of digital platforms and their influence on modern education, it is crucial to analyze the influences of multimodal instruction on learning in these environments, where engagement dynamics and learning experiences can vary markedly from traditional face-to-face classrooms.

This study sought to address this underexplored area by investigating how multimodal instruction influences grammar acquisition both within and outside the classroom in English language education. While prior research has underscored the potential of multimodal learning [15, 18], this study specifically focused on its application to grammar instruction, an area that remains a persistent challenge for learners, especially in digital learning environments. By integrating verbal, aural, visual, kinesthetic modalities, and semiotic elements such as symbols and images, multimodal learning offers a holistic, immersive approach to grammar acquisition.

This research presented a dual exploration: it analyzed students' experiences with multimodal instruction in both in-class and out-of-class contexts, and investigated the influence of these experiences on their grammar learning. Unlike earlier studies that focus solely on engagement within classrooms, this research aimed to uncover insights into how instructional multimodality can be leveraged to encourage autonomous and sustained grammar learning in digital spaces. By capturing students' perceptions and learning outcomes, this study is expected to provide educators with actionable strategies to enhance grammar instruction through multimodal approaches, ultimately bridging the gap between traditional pedagogical practices and digital learning trends.

II. Literature Review

A. Contemporary Approaches to English Grammar Learning

Recent developments in English grammar pedagogy indicate a transition from traditional rule-based methods to communicative, context-driven approaches, reflecting broader changes in language education theory. This transition indicates that grammar instruction should occur within meaningful communicative contexts that reflect real-world language use [4, 5]. The communicative approach to grammar instruction emphasizes both "focus on meaning" and "focus on form," suggesting that grammar comprehension improves when learners actively engage with language in ways that necessitate constructing meaning rather than merely memorizing rules [5]. This exposure enables learners to internalize grammatical structures naturally through encounters in various communicative contexts.

In Indonesian education, a similar evolution is occurring, as teachers progressively incorporate grammar instruction alongside activities that enhance both linguistic accuracy and communicative fluency [7]. This blended approach combines structured exercises with contextualized applications, aligning with theoretical perspectives that emphasize the advantages of enhancing grammatical fluency through practical use [26]. These methods enable students to navigate grammar as a functional tool in communication, creating more dynamic language learning environments that reflect real-world usage. The theoretical basis for this shift is found in the sociocultural theory of language learning, which posits that grammar serves as a functional tool for communication rather than a discrete set of rules. This viewpoint is consistent with Vygotskian principles, which assert that language acquisition is most effective through social interaction in meaningful contexts, allowing students to engage with grammar dynamically [27].

Despite empirical support for the communicative approach in enhancing learner engagement and comprehension, challenges persist, especially in achieving a balance between fluency and accuracy. Harmer [5], Lin *et al.* [28], and Agustien [4] argue that although communicative methods can alleviate the cognitive burden of grammar acquisition, they often do not attain the level of grammatical accuracy required in examination-focused environments. Critics in the field emphasize the necessity for additional empirical research to determine the most effective methodologies that combine communicative grammar instruction with systematic and rigorous focus on form. The studies highlight the necessity of a dual emphasis on meaningful communication and grammatical accuracy to enhance language proficiency and learner engagement in various educational contexts [4, 5].

B. Application of Multimodal Approach in English Language Learning

Multimodal approaches in language learning have become increasingly important due to the complex literacy demands of the digital age, representing a notable expansion in the field of language pedagogy. Multimodality is defined as the integration of diverse communicative modes, including visual, auditory, gestural, and linguistic elements. This concept aligns with modern frameworks that consider language as a semiotic resource [9]. This approach in English language learning encompasses not only vocabulary acquisition but also various semiotic resources, including tone, body language, and visual aids, which are essential for comprehensive communication [29]. Multimodal approaches support learners in engaging with language comprehensively, enhancing retention and facilitating practical applications in authentic communication settings [10].

Olivier's [8] framework on multimodal learning

categorizes multimodal approaches into individual, interactional, instructional, and institutional dimensions, highlighting their potential reach. Individual multimodality emphasizes cognitive engagement, wherein learners integrate multiple modes cohesively, thereby supporting theories related to cognitive load reduction in multimedia learning [30]. Interactional multimodality highlights the integration of various channels—textual, auditory, and visual—enhancing meaning-making processes in accordance with Mayer's [31] multimedia learning theory. Instructional multimodality emphasizes pedagogical strategies that educators utilize to effectively integrate diverse modes within different instructional contexts, aligning with the theory of situated learning, which posits that context and interaction are essential for knowledge construction [32]. Institutional multimodality pertains to the ways in which educational institutions facilitate multimodal learning environments, integrating face-to-face, blended, or fully online models to meet changing literacy requirements [8].

Multimodal learning in English language instruction offers significant pedagogical benefits, especially in improving student engagement and promoting learner autonomy. Research demonstrates that multimodal instruction, enhanced by digital technology, markedly increases learner motivation and engagement [18]. Bosch *et al.* [19] corroborate that multimodal and blended learning environments promote self-directed learning, facilitating a transition from passive to active participation in language acquisition. Tour and Barnes [17] assert that the incorporation of digital tools in multimodal instruction improves language skills and provides students with essential digital literacy for contemporary communication. This approach aligns with the theory of multiliteracies, which underscores the necessity for adaptive literacies in a globalized context [33]. Research by Yeh [34] illustrates the capacity of video-making activities to enhance learners' multiliteracy awareness, an essential component of language education in digitally mediated contexts.

Multimodal approaches, while possessing notable strengths, also face critiques. Researchers identify possible disadvantages, including the risk of cognitive overload, particularly for learners who are not accustomed to handling multiple modalities at once. The risk is especially significant for novices who may find it challenging to integrate varied inputs, resulting in disjointed learning experiences [35]. Magnusson and Godhe [16] emphasize that although multimodal approaches increase engagement, they necessitate meticulously organized pedagogical designs to avoid superficial engagement, wherein learners may interact with the media without attaining deep comprehension. Current literature suggests the implementation of balanced, scaffolded multimodal designs that facilitate learners' progression through increasingly complex modes, thereby enhancing knowledge acquisition while maintaining cognitive coherence [9, 31].

III. Methods

This research utilized a quantitative survey design to look into undergraduate students' perceptions of multimodal learning and its influence on grammar acquisition within a hybrid instructional model that combined offline and online multimodal resources. Grounded in Vygotskian sociocultural theory, which emphasizes language learning through social interaction in meaningful contexts [27], the research emphasized instructional multimodality by integrating visual, gestural, spatial, and linguistic cues to facilitate dynamic and contextualized grammar learning experiences. The approach aligns with Olivier's [8] framework on instructional multimodality, highlighting the importance of varied pedagogical strategies and situated learning theory, in which knowledge construction is influenced by interaction and context. The hybrid instructional model (Fig. 1) demonstrates student engagement with multimodal instructional strategies across four interconnected dimensions: structured exercises, contextualized applications, multimodal content, and social interaction. The study aimed to provide measurable, statistically analyzable data on the influences of instructional multimodality in enhancing grammar learning perceived by students through the integration of these elements.

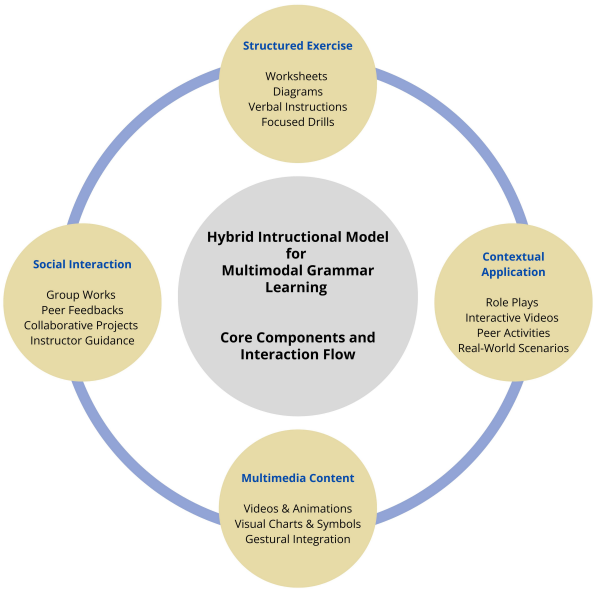

Fig. 1. The hybrid instructional model.

A. Population and Sample

The study's population comprised 523 undergraduate students enrolled in the English Language Education and English Literature programs at a state university in West Sumatera from 2021 to 2023. The inclusion of these students in the population is based on their enrollment in a range of grammar courses, from basic to advanced levels, which is pertinent for assessing the influences of multimodality-based grammar instruction.

From this population, a sample of 212 students was formed using voluntary response sampling. The questionnaire was distributed to all 523 students, and only those who willingly participated and completed the questionnaire were included in the study. This technique guaranteed voluntary participation, aligning with ethical standards and targeting individuals genuinely interested in contributing to the research. The criteria for participant inclusion were: (1) recent firsthand experience with grammar instruction to ensure the relevance of their responses to the evaluation of multimodality-based learning, (2) enrollment during the specified academic years to align with contemporary teaching methodologies and instructional materials, and (3)

willingness to participate in the study.

The sample's demographic distribution included 71 students from the 2021 cohort (ages 22–23), 61 students from the 2022 cohort (ages 20–22), and 80 students from the 2023 cohort (ages 18–20). This distribution encompassed various academic stages and experiences, offering a balanced view of students' exposure to multimodal grammar instruction in both traditional and technology-mediated learning contexts.

A sample size of 212 participants is deemed adequate for quantitative research in education, adhering to established standards that ensure reliable and generalizable results. The study utilized voluntary response sampling to gather insights from students who were most inclined to share their experiences, thereby providing valuable information on the influences of multimodal instruction in grammar learning in higher education. This method may introduce self-selection bias; however, the sample's diversity mitigates this limitation and enhances the study's contribution to understanding instructional multimodality.

B. Instrument

The primary instrument for data collection was a structured, self-administered questionnaire comprising 42 items, each derived from Olivier's [8] framework on instructional multimodality (see Table 1). This framework supports the integration of diverse sensory and semiotic resources, which informed the questionnaire's emphasis on visual, auditory, textual, and interactive digital components utilized in grammar instruction. The items were designed to reflect on various aspects of multimodal engagement, encompassing resources supplied by instructors (e.g., multimedia presentations, digital exercises) and students' autonomous exploration (e.g., online videos, language applications). A four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree), was employed to capture nuanced perceptions, facilitating a structured comparison of agreement levels across various aspects of multimodal learning.

Table 1. Indicators of questionnaire

No	Aspects	Indicators	Statement Numbers
1	Learner's Modalities	Vision	1, 2, 3
		Audition	4, 5, 6
		Touch	7, 8, 9
2	Background Knowledge	learning experiences	10, 11, 12
3	Available Learning Instruments	Books	13, 14, 15
		Multimedia	16, 17, 18
		Software	19, 20, 21
4	Verbal & Non-Verbal Contents	Text	22, 23, 24
		Image	25, 26, 27
		Sound	28, 29, 30
		Social media feed	31, 32, 33
		Websites	34, 35, 36
		Applications	37, 38, 39
		Infographics	40, 41, 42

C. Data Collection

The data collection process employed an online platform to improve accessibility and facilitate the efficient gathering of responses from the target participants. The online format enabled students to complete the questionnaire at their convenience, reducing logistical challenges and facilitating broad participation. A questionnaire was administered to all undergraduate students enrolled in the English Language Education and English Literature programs from 2021 to 2023. A total of 212 responses were received. The data collected were verified for completeness prior to analysis to ensure the reliability and validity of the findings. The response rate and online distribution method enhanced the study's robustness and generalizability by obtaining a diverse sample of students from different academic backgrounds and learning

D. Data Analysis

Data were analyzed through descriptive statistical methods to elucidate students' perceptions of multimodality-based learning. The questionnaire responses, organized using a four-point Likert scale (Strongly Disagree—SD, Disagree—D, Agree—A, Strongly Agree—SA), were analyzed on an item-by-item basis to ascertain the frequency and distribution of responses. Frequency and percentage analyses were performed to determine the proportion of participants in each response category, providing a detailed understanding of their perceptions. The analyses offered insights into the influence of multimodal learning resources on various dimensions of grammar acquisition, such as engagement, comprehension, and retention.

The study categorized the 42 Likert-scale items into thematic groups that reflect different aspects of multimodal instruction, including visual aids, audio resources, interactive tools, and integrated multimedia content. The response distributions for each category were analyzed to identify the strengths and weaknesses of these instructional elements. This approach enabled the study to identify the multimodal elements that supported grammar learning and to highlight areas for pedagogical enhancement.

The results of these analyses provide evidence-based recommendations for improving multimodal grammar instruction. The study identifies instructional components that enhance engagement, comprehension, and retention, offering practical insights for educators and instructional designers. The findings advance the formulation of targeted multimodal strategies aimed at enhancing students' learning outcomes and satisfaction, in accordance with modern educational practices.

IV. Result and Discussion

A. Results

1) Instructional multimodality in grammar learning according to learners' modalities

The analysis provides a thorough investigation on learners' responses to instructional multimodality in grammar acquisition, emphasizing three key sensory modalities: visual, auditory, and tactile (see Table 2). The data show clear patterns in learners' preferences, perceptions, and the reported influences of different sensory modalities on their understanding and retention of English grammar.

Table 2 illustrates learners' perceptions of the role of multimodal aids in grammar comprehension, emphasizing a pronounced preference for visual elements. A substantial 71.83% of respondents affirmed that images and diagrams were essential for internalizing grammatical rules, with 23.47%

acknowledging their benefits and only 4.7% expressing dissent. Visual representation, particularly through error highlighting and structural scaffolding, garnered strong support, as 56.81% strongly agreed and 34.27% agreed on their importance. Similarly, visual feedback proved influential, with 62.91% of learners endorsing its effectiveness. In contrast, auditory modalities were positively received but with comparatively subdued enthusiasm. While 51.17% of learners strongly supported audio materials and 32.86% agreed on their utility in grammar comprehension, a notable 15.03% disagreed, reflecting diverse auditory preferences. The presentation of grammar rules in audio format elicited favorable responses from 41.78% strongly agreeing and 39.91% agreeing, suggesting auditory aids as complementary but not universally favored.

Table 2. The Influences of instructional multimodality in grammar learning in terms of learner's modalities

Aspect	Statement	SD (n, %)	D (n, %)	A (n, %)	SA (n, %)
Vision	The use of visual aids (e.g., images, videos, diagrams, written grammatical examples) helped me understand English grammar concepts better.	5 (2.35%)	5 (2.35%)	50 (23.47%)	153 (71.83%)
	Visual representations of grammar structures (e.g., charts, tables) enhance my learning experience and help me remember grammar rules.	3 (1.41%)	15 (7.04%)	73 (34.27%)	121 (56.81%)
	Visual feedback (e.g., highlighted errors) is effective in improving my grammar skills.	3 (1.41%)	11 (5.16%)	64 (30.05%)	134 (62.91%)
Audition	Listening to audio materials (e.g., recordings, podcasts, explanations) enhances my learning experience and improves my understanding of English grammar.	5 (2.35%)	27 (12.68%)	70 (32.86%)	109 (51.17%)
	Hearing grammar exercises read aloud aids my learning.	3 (1.41%)	35 (16.43%)	85 (39.91%)	89 (41.78%)
	I benefit from listening to grammar discussions and explanations in class.	4 (1.88%)	15 (7.04%)	83 (38.97%)	110 (51.64%)
Touch	Hands-on activities (e.g., manipulating objects, role-playing) help me understand grammar rules better.	7 (3.29%)	32 (15.02%)	82 (38.50%)	90 (42.25%)
	I find it easier to remember grammar rules when they are reinforced through touch-based activities.	9 (4.23%)	47 (22.07%)	77 (36.15%)	79 (37.09%)
	Grammar exercises involving physical interaction (e.g., building sentences with blocks) improve my understanding.	10 (4.69%)	28 (13.15%)	76 (35.68%)	97 (45.54%)

Tactile learning, involving hands-on activities such as sentence construction with physical tools, elicited more nuanced feedback. While 42.25% of learners strongly agreed that experiential activities enhanced grammar comprehension and 38.50% agreed, 18.31% expressed disagreement, indicating mixed efficacy. Tactile methods demonstrated moderate support for memory retention, with 37.09% strongly agreeing and 36.15% agreeing, though 26.30% expressed disagreement or strong disagreement. This divergence highlights that tactile engagement, while valuable for some learners, may be contextually effective and not universally applicable. Collectively, the data underscores the varying degrees of effectiveness among visual, auditory, and tactile modalities, advocating for a multimodal approach tailored to individual learning preferences.

2) Instructional multimodality in grammar learning according to learners' background knowledge

The analysis in Table 3 shows the influence of learners' prior knowledge and previous grammar instruction experiences on their responses to multimodal grammar learning. The data highlight the significant impact of pre-existing grammatical knowledge on engagement with new instructional modalities.

A significant portion of respondents (50.70%) agreed, with 30.52% strongly agreeing, that their prior grammar learning experiences boosted confidence in tackling new grammar rules, underscoring the supportive role of background knowledge in multimodal learning contexts. Similarly, familiarity with English grammar enhanced class participation, as 53.99% agreed and 36.62% strongly agreed, although 8.92% objected. The integration of prior knowledge with new material further benefited most learners, with 44.60% agreeing and 35.21% strongly agreeing that it improved learning outcomes. However, 19.72% faced challenges in synthesizing new information with their existing knowledge, indicating that while multimodal approaches are broadly effective, their success may vary depending on learners' prior exposure and familiarity with grammar.

Table 3. The influences of instructional multimodality in grammar learning in terms of learners' background knowledge

Statement	SD (n, %)	D (n, %)	A (n, %)	SA (n, %)
I feel confident in my ability to learn new grammar rules because of my previous grammar learning experiences.	3 (1.41%)	35 (16.43%)	108 (50.70%)	65 (30.52%)
My familiarity with English grammar helps me participate more actively in class discussions.	2 (0.94%)	17 (7.98%)	115 (53.99%)	78 (36.62%)
Understanding how new grammar rules fit into what I already know enhances my overall learning experience.	20 (9.39%)	22 (10.33%)	95 (44.60%)	75 (35.21%)

3) Instructional multimodality in grammar learning according to available learning instruments

Table 4 presents learners' views regarding the influence of accessible resources—books, multimedia, and software—within a multimodal framework. The findings reveal diverse responses to traditional and digital resources, demonstrating the impact of various tools on learners' understanding and retention of grammatical concepts.

Table 4. The Influence of instructional multimodality in grammar learning in terms of available learning instruments

Aspect	Statement	SD (n, %)	D (n, %)	A (n, %)	SA (n, %)
Books	The grammar textbooks provided are helpful in understanding English grammar concepts.	26 (12.21%)	36 (16.90%)	83 (38.97%)	67 (31.46%)
	The exercises in the grammar books enhance my learning experience.	5 (2.35%)	19 (8.92%)	84 (39.44%)	104 (48.83%)
	Reading grammar rules and examples in books helps me retain information and understand grammar better.	6 (2.82%)	22 (10.33%)	84 (39.44%)	100 (46.95%)
Multimedia	I find learning grammar through multimedia (e.g., videos, interactive presentations) more engaging.	9 (4.23%)	20 (9.39%)	56 (26.29%)	127 (59.62%)
	The use of multimedia helps me remember grammar rules more effectively.	10 (4.69%)	8 (3.76%)	78 (36.62%)	115 (53.99%)
	I benefit from the variety of multimedia tools used to teach grammar in class.	6 (2.82%)	20 (9.39%)	74 (34.74%)	112 (52.58%)
Software	The feedback provided by grammar software helps me improve my grammar skills.	10 (4.69%)	13 (6.10%)	90 (42.25%)	99 (46.48%)
	Software tools allow me to learn at my own pace, enhancing my understanding of grammar.	7 (3.29%)	14 (6.57%)	99 (46.48%)	92 (43.19%)
	Using software for grammar practice helps me track my progress and identify areas for improvement.	8 (3.76%)	15 (7.04%)	85 (39.91%)	103 (48.36%)

Traditional resources, such as textbooks, received mixed responses regarding their effectiveness in grammar comprehension. While 38.97% agreed and 31.46% strongly agreed that textbooks were beneficial, 29.11% expressed dissatisfaction, suggesting that traditional materials may not fully engage all learners in a multimodal environment. However, grammatical exercises within textbooks were well-received, with 48.83% strongly agreeing and 39.44% agreeing that these exercises enhanced their learning. In a similar vein, the utility of reading rules and examples in books was supported by 46.95% strongly agreeing and 39.44% agreeing, though 13.15% disagreed, highlighting variability in learner preferences for textual materials.

Multimedia resources demonstrated higher levels of engagement and effectiveness, with 59.62% of learners strongly agreeing and 26.29% agreeing that multimedia tools, such as videos and interactive presentations, enhanced their learning experience, while only 13.62% expressed disagreement. These tools also supported rule retention, with 53.99% strongly agreeing and 36.62% agreeing, emphasizing the advantage of multimedia in engaging multiple sensory inputs. Software tools further reinforced grammar skills, as 46.48% strongly agreed and 42.25% agreed on their utility, with only 10.79% disagreeing. These tools were particularly valued for fostering self-directed learning and providing personalized feedback, as evidenced by 48.36% strongly agreeing and 39.91% agreeing on their role in monitoring progress and identifying improvement areas. Collectively, these findings highlight the growing relevance of multimedia and technology-mediated learning in multimodal instruction.

4) Instructional multimodality in grammar learning in digital environments: Verbal and non-verbal content

Table 5 illustrates the substantial influence of verbal and non-verbal digital content, including text, images, audio, and interactive media, on learners' understanding and engagement with grammar. The findings underscore the complexity of multimodal digital environments, in which verbal and non-verbal elements interact to enhance the learning experience.

Table 5. The influence of instructional multimodality in grammar learning in terms of verbal & non-verbal contents in digital learning environment

Aspect	Statement	SD (n, %)	D (n, %)	A (n, %)	SA (n, %)
Text	Reading digital text materials helps me understand English grammar concepts better.	2 (0.94%)	29 (13.62%)	107 (50.23%)	73 (34.27%)
	Text-based explanations in digital resources are clear and easy to follow.	7 (3.29%)	36 (16.90%)	96 (45.07%)	73 (34.27%)
	Digital texts provide sufficient examples that enhance my understanding of grammar rules.	5 (2.35%)	34 (15.96%)	98 (46.01%)	75 (35.21%)
Image	Images used in digital learning materials help clarify English grammar concepts.	3 (1.41%)	14 (6.57%)	104 (48.83%)	91 (42.72%)
	Visual aids (e.g., charts, diagrams) in digital resources make learning grammar more engaging.	4 (1.88%)	14 (6.57%)	93 (43.66%)	101 (47.42%)
	I find it easier to remember grammar rules when accompanied by relevant images.	4 (1.88%)	14 (6.57%)	71 (33.33%)	123 (57.75%)
Sound	Audio explanations in digital resources improve my understanding of English grammar.	3 (1.41%)	28 (13.15%)	96 (45.07%)	83 (38.97%)
	Listening to pronunciation and intonation helps me grasp grammar concepts better.	1 (0.47%)	21 (9.86%)	96 (45.07%)	94 (44.13%)
	Sound-based activities make learning grammar more enjoyable.	2 (0.94%)	16 (7.51%)	96 (45.07%)	96 (45.07%)
Social Media Feed	Learning grammar through social media feeds (e.g., educational posts, videos) is effective.	3 (1.41%)	14 (6.57%)	88 (41.31%)	106 (49.77%)
	Social media content provides relevant and up-to-date examples of grammar usage.	2 (0.94%)	17 (7.98%)	77 (36.15%)	115 (53.99%)
	Engaging with grammar-related content on social media helps reinforce learning.	2 (0.94%)	11 (5.16%)	74 (34.74%)	125 (58.69%)

Websites	Educational websites offer comprehensive explanations of grammar concepts.	2 (0.94%)	18 (8.45%)	93 (43.66%)	99 (46.48%)
	Websites offer beneficial grammar exercises and tools.	2 (0.94%)	18 (8.45%)	81 (38.03%)	111 (52.11%)
	Interactive tools on websites aid grammar learning.	0 (0.00%)	27 (12.68%)	92 (43.19%)	90 (42.25%)
Applications	Learning grammar through applications is convenient and effective.	3 (1.41%)	11 (5.16%)	83 (38.97%)	113 (53.05%)
	Interactive exercises enhance understanding in applications.	3 (1.41%)	21 (9.86%)	90 (42.25%)	97 (45.54%)
	Instant feedback from applications improves grammar skills.	4 (1.88%)	8 (3.76%)	77 (36.15%)	123 (57.75%)
Infographics	Infographics help in retaining grammar concepts.	2 (0.94%)	9 (4.23%)	76 (35.68%)	124 (58.22%)
	Infographics make grammar learning visually engaging.	5 (2.35%)	8 (3.76%)	69 (32.39%)	130 (61.03%)
	Data visualizations (e.g., graphs) clarify grammar trends.	5 (2.35%)	7 (3.29%)	82 (38.50%)	118 (55.40%)

Text-based digital content received favorable feedback, with 50.23% of learners agreeing and 34.27% strongly agreeing that it enhanced their comprehension of grammar concepts, although 14.56% expressed disagreement, indicating variation in text-processing preferences. The provision of grammar examples through digital texts was similarly effective, supported by 46.01% agreeing and 35.21% strongly agreeing, though 18.31% indicated the need for supplementary modes. These findings suggest that while digital texts offer valuable resources for grammar learning, they may need to be integrated with other modalities to address diverse learner needs effectively. Visual aids, such as images and infographics, were particularly impactful, with 48.83% agreeing and 42.72% strongly agreeing that they improved the understanding of grammatical concepts. Additionally, visual elements like charts and diagrams garnered strong support, with 47.42% strongly agreeing and 43.66% agreeing, affirming the role of visual representation in enhancing retention and conceptual clarity.

Audio-based resources also demonstrated significant utility, with 45.07% agreeing and 38.97% strongly agreeing that auditory explanations supported grammar comprehension, while 14.56% expressed disagreement. Listening activities further reinforced this benefit, as 44.13% strongly agreed and 45.07% agreed on their effectiveness. The integration of auditory explanations with visual and text-based elements appears to optimize engagement and mastery of grammatical content. These results stress the value of employing a multimodal approach that combines verbal and non-verbal elements, emphasizing the synergy of diverse modalities in fostering comprehensive learning outcomes in grammar instruction.

B. Discussion

This study underscores the critical role of multimodal instructional strategies in grammar acquisition, providing both empirical support and nuanced insights into their advantages and challenges. The strong preference for visual components, including visual aids, diagrams, and feedback mechanisms, aligns with prior research that highlights the power of visual representation in simplifying complex grammatical structures and improving retention [23, 36]. Visual stimuli reduce cognitive load by presenting abstract concepts in a tangible format, thereby enabling learners to process and retain information more efficiently. The current findings reinforce these assertions, particularly in contexts where text-based explanations alone are insufficient for understanding abstract linguistic concepts [37, 38]. However, this study adds depth by emphasizing the necessity for effectively designed and context-appropriate visual materials. Poorly curated visuals, as noted in earlier critiques, risk overwhelming learners and detracting from the intended cognitive benefits. This suggests that the success of visual aids hinges not only on their inclusion but also on their pedagogical execution.

The varying impacts of sensory modalities observed in this study contribute to a broader understanding of learner preferences and instructional effectiveness. While auditory resources, such as audio materials and discussions, were valued by some learners, their effectiveness was contingent on individual preferences, corroborating previous findings that auditory input often plays a supportive role in grammar acquisition [39]. These results align with the sensory modality hierarchy proposed in existing literature, which places visual input above auditory input for most learners in terms of comprehension and retention. Nevertheless, the observed preference for auditory materials among a subset of learners underscores the importance of integrating multiple sensory channels to accommodate diverse learning styles. The study also highlights the limited effectiveness of kinesthetic methods, such as hands-on activities, in teaching abstract grammatical rules, a finding consistent with Pinto-Llorente *et al.* [40]. However, the value of kinesthetic approaches in reinforcing memory and promoting active engagement supports experiential learning theories [41]. These findings advocate for a balanced multimodal approach that leverages the strengths of each sensory modality based on specific learning objectives.

The role of learners' prior knowledge emerged as a critical factor in influencing confidence, class participation, and the ability to integrate new information. The study's findings affirm the theory of cumulative knowledge acquisition, which posits that prior knowledge serves as a cognitive scaffold for assimilating new content [42]. Learners with strong grammatical foundations demonstrated higher levels of confidence and engagement, which aligns with research suggesting that prior knowledge facilitates faster and deeper integration of new material [43]. However, the study also highlights challenges for learners with limited prior knowledge, emphasizing the need for instructional strategies that provide gradual scaffolding and structured reinforcement to prevent learning gaps [14, 44]. These findings offer critical implications for differentiated instruction, advocating for personalized approaches that adapt to individual learners' starting points to optimize outcomes.

The preference for modern multimodal tools, including multimedia and software, over traditional textbooks reflect a significant shift toward dynamic, student-centered learning. Multimedia tools, such as videos, interactive presentations, and software platforms, have been shown to increase engagement and foster self-directed study, findings that are consistent with prior studies [38, 45]. These tools not only enhance grammar learning by providing diverse learning pathways but also address individual preferences by enabling students to explore content through multiple perspectives [46]. Grammar software's ability to deliver immediate feedback further highlights its role in promoting autonomy and self-regulation, essential components of successful language acquisition [47]. However, this study also echoes concerns raised by Dinçer and Polat [1] regarding the potential for cognitive overload when multimedia content is not properly curated. These findings underline the importance of balanced instructional designs that integrate digital tools with traditional resources to achieve optimal learning outcomes [48].

Lastly, the integration of verbal and non-verbal components in digital learning environments was reaffirmed as a powerful strategy for enhancing grammar acquisition. While text-based materials remain foundational, the incorporation of multimedia elements, such as images, audio, infographics, and interactive platforms, significantly enhances comprehension and engagement by creating a multi-sensory learning experience. These findings align with multimodal learning theories, which suggest that exposure to complementary input modes facilitates more effective meaning construction [29, 49]. The work of Kress and Bezemer [50] on digital multimodal literacy further supports this view, positing that integrating diverse media not only enhances learning but also equips learners with skills for practical communicative situations in digitally mediated contexts. However, as Alamri *et al.* [51] along with Apandi and Raman [52] caution, excessive or poorly integrated media use risks causing distraction rather than engagement. This highlights the importance of meticulous instructional design that prioritizes depth of understanding over superficial interaction with multimodal content.

This study's findings emphasize significant implications for improving grammar acquisition via multimodal instructional methods. The preference for visual aids highlights the importance of integrating well-designed and contextually relevant visual elements, including diagrams, infographics, and error-feedback mechanisms, into educational materials. These tools clarify abstract grammatical concepts and decrease cognitive load, especially aiding learners who find text-based explanations challenging. Professional development programs must prioritize equipping educators with the necessary skills to design and integrate visual aids effectively into their teaching practices. The differing effectiveness of auditory and kinesthetic modalities indicates the necessity for a flexible, learner-centered approach. Auditory resources, including narrated examples and classroom discussions, should enhance other modalities, while kinesthetic activities can be utilized to strengthen memory and promote experiential learning. These strategies highlight the importance of a multimodal framework that addresses varied learner preferences and utilizes the distinct advantages of each modality.

The research underlines the importance of prior knowledge in influencing learners' confidence, engagement, and capacity to assimilate new information, thereby highlighting the necessity for adaptive and differentiated instructional approaches. Diagnostic tools must be utilized to evaluate learners' baseline knowledge, allowing educators to create customized scaffolding strategies to address individual requirements. Gradual scaffolding and structured reinforcement are essential for learners with limited prior knowledge to prevent learning gaps and promote inclusivity. The preference for multimedia and digital tools instead of traditional textbooks indicates a transition toward dynamic, student-centered learning environments. It is essential for curriculum developers and policymakers to prioritize the integration of digital tools, including interactive grammar software, videos, and gamified platforms, into language instruction to enhance engagement and promote self-regulation. Balancing traditional resources with curated digital content is crucial to prevent cognitive overload. The integration of verbal and non-verbal elements in multimodal environments must adhere to evidence-based practices, incorporating text, audio, visuals, and interactive platforms to facilitate immersive, multi-sensory learning experiences. Training in digital literacy for both educators and learners is essential for optimizing the advantages of multimodal tools and addressing the requirements of digitally mediated communication.

V. Conclusion

This study underscores the transformative potential of instructional multimodality on improving engagement, understanding, and retention of grammatical concepts in language learning. By integrating various communication modes—visual, auditory, and kinesthetic—within a cohesive instructional framework, multimodal approaches enhance an inclusive learning environment that addresses diverse learner preferences. The findings indicate that an effective instructional strategy combining visual aids (e.g., slides and pictures), interactive digital resources (such as online videos and grammar software), and traditional teacher-led instruction addresses diverse sensory needs and fosters a dynamic educational environment that is conducive to effective grammar acquisition. These insights confirm the importance of implementing multimodal instructional strategies that integrate traditional and digital tools, providing a flexible approach that accounts for the changing needs of contemporary learners in both physical and virtual learning environments.

The present study has several limitations that require consideration and suggest directions for future research. The exclusive emphasis on instructional multimodality may fail to encompass the complete spectrum of learner diversity within various cultural and linguistic contexts. Furthermore, dependence on self-reported preferences may lead to response bias, as learners' perceived preferences may not consistently correspond with the most effective approaches for grammar acquisition. Future research should utilize longitudinal and experimental designs to evaluate the long-term effects of multimodal approaches on grammar learning and assess adaptive multimodal models that respond

dynamically to individual learners' progress. Investigating advanced digital tools, including artificial intelligence-driven personalization, may yield more customized and scalable solutions for multimodal grammar instruction, enhancing comprehension of how these technologies can improve instructional methods for diverse learner populations.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

The study was designed and first drafted by Siti Rahimah Yusra and Rizaldy Hanifa. In the writing process, Rizaldy Hanifa and Mia Fahmiati worked collaboratively searching for studies and developing the manuscript. The data was gathered and extracted by Siti Rahimah Yusra. After that, Siti Rahimah Yusra and Rizaldy Hanifa analyzed the data and wrote the discussion according to the research findings. Lastly, Siti Rahimah Yusra and Rizaldy Hanifa finalized the research paper and Andri Wardana proofread and reviewed the article for final check. All authors had approved the final version.

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