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Application of Fuzzy Delphi Method to Identify the Construct for Designing and Developing the Multimodal Learning Framework for Writing Skills in ESL Context

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ABSTRACT

The increasing complexity of educational demands in the 21st century has emphasized the need for innovative pedagogical frameworks, particularly in enhancing writing skills among ESL students. This study explores the application of the Fuzzy Delphi Method (FDM) to identify and validate the critical constructs necessary for designing and developing a Multimodal Learning Framework aimed at improving writing skills in academic settings. The design of this study is a quantitative study using the Fuzzy Delphi technique. A questionnaire instrument was used to collect research data. Eleven experts in TESL, educational technology, multimodal learning and curriculum participated in the study. Data analysis results showed that the experts accepted all these elements through the expert consensus value above 75%, the threshold value (d) ≤ 0.2, and the fuzzy score (A) $\geq \alpha$ - cut value = 0.5. Therefore, it shows that these elements have gained expert consensus and are needed to design and develop the Multimodal Learning Framework for Writing Skills. The findings not only contribute to the theoretical understanding of multimodal learning in writing instruction but also offer practical guidelines for educators aiming to implement this framework in foundation-level classrooms. This research underscores the value of FDM in educational design, particularly in areas where expert judgment is critical for addressing complex instructional challenges.

Keyword: Multimodal learning, Fuzzy Delphi, Writing Skills, ESL

INTRODUCTION

The integration of multimodal learning approaches in education has gained significant attention in recent years, particularly in the context of developing writing skills among students. Multimodal learning, which involves the use of various modes of communication such as

visual, auditory, and kinaesthetic elements, has been shown to enhance student engagement and improve learning outcomes (Jewitt, 2013; Kress, 2010). However, designing an effective multimodal framework requires careful consideration of various constructs that are critical to its success. The Fuzzy Delphi Method (FDM) has emerged as a valuable tool for identifying and validating these constructs by facilitating expert consensus in complex decision-making scenarios (Hsu & Sandford, 2007). This study applies the FDM to develop a comprehensive Multimodal Learning Framework specifically aimed at improving writing skills in academic settings, addressing the need for more innovative and inclusive educational strategies.

LITERATURE REVIEW

The integration of technology in multimodal learning environments fosters creativity and innovation among ESL foundation students in academic writing. Research has shown that allowing students to use various modes—such as images, videos, and audio—enables them to express their ideas more creatively and innovatively, leading to more engaging and original writing pieces (Tan, 2022). Furthermore, technology has been found to significantly enhance student engagement and participation in multimodal academic writing activities. By incorporating aesthetically pleasing visuals, such as well-designed layouts, typography, and colour schemes, comprehension and retention of academic content are also improved among ESL students (Tan, 2023). Moreover, the influence of thoughtful visual design on the effectiveness of multimodal texts cannot be overstated; it plays a crucial role in enhancing the audience's understanding and retention of the presented content. Studies have highlighted how students appreciate the creative aspects of multimodal writing, which in turn boosts their motivation and engagement in the learning process (Allagui, 2022). This suggests that aesthetic elements are pivotal in shaping students' attitudes towards writing tasks. Additionally, the integration of AI technologies has the potential to further personalize the learning experience in multimodal academic writing contexts for ESL students. Research by Arslan (2020) indicates that multimodal writing practices positively impact writing skills and learner motivation. While the primary focus is on the multimodal approach, the findings align with the benefits of utilizing technology, including AI, to enhance writing outcomes by personalizing learning experiences. This comprehensive approach to incorporating multiple modes and technologies can lead to more effective and enjoyable academic writing experiences for ESL learners.

Research Design

This study employed the Fuzzy Delphi technique to achieve expert consensus on the elements necessary for the framework development. The Fuzzy Delphi technique was chosen for its efficiency in saving time and costs associated with handling questionnaires, and for enabling experts to consistently provide their views (Mohd Jamil et al., 2013). According to Mohd Jamil et al. (2017), this technique is effective for obtaining expert consensus on complex issues. Unlike the traditional Delphi method, Fuzzy Delphi offers a more streamlined approach that still ensures the reliability of expert opinions. A minimum of 10 experts is typically recommended for Fuzzy Delphi studies to achieve a high level of agreement among participants (Adler & Ziglio, 1996; Jones & Twiss, 1978). In this study, 11 experts were selected using a purposive sampling technique, focusing on individuals with expertise in TESL, technology, multimodal learning, and curriculum development. The selection criteria required experts to have PhD degree and a minimum of five years of experience in their respective fields. This approach aligns with the criteria set forth by Berliner (2004), who suggested that expertise is often reflected by more than five years of experience, and Gambatese et al. (2008), who emphasized the importance of high academic qualifications in expert selection.

Questionnaire for Experts

The researchers utilized a comprehensive literature review to develop the research questionnaire for the Fuzzy Delphi method. The creation of questionnaire items can be informed by a thorough literature review, pilot studies, and relevant experiences (Skulmowski et al., 2017). According to more recent studies, such as Hsu et al. (2020), the formulation of research items and content elements should be grounded in a detailed review of existing literature within the study's focus area. Following the adaptation of the questionnaire based on the literature, it was subjected to review by two experts who provided feedback. Modifications were made to the questionnaire in response to this feedback, and it was subsequently tested for reliability. The constructs showed strong reliability, with Cronbach's alpha values of 0.891 for incorporating technology, 0.871 for aesthetic value, and 0.911 for integration of artificial intelligent. To address the research questions, a five-point Likert scale questionnaire, as detailed in Table 1, was distributed to the experts to achieve consensus on the items.

Table 1. 7-point Fuzzy Scale

Level	Level of Agreement	Fuzzy Scale
1	Strongly Agree	(0.6,0.8,1.0)
2	Agree	(0.4,0.6,0.8)
3	Undecided	(0.2,0.4,0.6)
4	Disagree	(0.0,0.2,0.4)
5	Strongly Disagree	(0.0,0.0,0.2)

Data Analysis Questionnaire

The data analysis was conducted systematically, with the experts' opinions meticulously analysed using Microsoft Excel, as recommended by Ramlie et al. (2014), Mohd Jamil et al. (2017), and Mohd Jamil and Mat Noh (2020). In the Fuzzy Delphi technique, two key prerequisites must be adhered to: the Triangular Fuzzy Number (TFN) and the Defuzzification Process. The Triangular Fuzzy Number is particularly important, with one of its conditions being that the Threshold (d) value must be ≤ 0.2. Consensus among experts is considered achieved when this value is equal to or less than 0.2, as established by Cheng & Lin (2002) and Chen (2000). The following formula is employed to calculate this threshold:

$$d(\tilde{m},\tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}$$

The second condition for the Triangular Fuzzy Number involves assessing the percentage of expert agreement. According to the traditional Delphi technique, a consensus is reached and accepted when the agreement among the expert group exceeds 75% (Chu & Hwang, 2008; Murray & Hammons, 1995). In contrast, the Defuzzification Process involves determining the fuzzy (A) score value, which is based on the α-cut value of 0.5 (Tang & Wu, 2010; Bodjonava, 2006). If the fuzzy score (A) is 0.5 or greater, the item being measured is accepted; if it is below 0.5, the item is rejected. The calculation of the fuzzy (A) score value is carried out using the following formula:

A= (1/3)*(m1 + m2 + m3)

1. Research Findings

6.1 Experts Information

The selection of experts according to Jones & Twiss (1978) is 10-50. Adler and Ziglio (1996) mention that the number of experts in the Delphi method is 10-15, if there is high uniformity

among the experts. The term 'expert' which is based on the operational definition and based on Tajul Ariffin's (1997) recommendations namely possess good personality, well respected in the professional circle, number of papers presented local and abroad, studies conducted and academic publications. As such, the criteria are either of the three that are:

1. A PhD holder in English language fields or more than five years' experience teaching English course or more than five years of teaching using English as medium of instruction.
2. Has depth knowledge in computer and technology, multimodal learning.
3. Regarded as technologist who utilised technology in teaching his/her subject matter.

Based on the criteria, 11 university academicians have been shortlisted. The experts have been identified from 9 local and 2 abroad universities that produced ESL undergraduates or have English programs. With the criteria put forward and constraints, this study will have 11 expert's panels from the fields of English language as well as instructional design.

6.2 Expert Consensus on Multimodal Learning Framework

In this incorporating technology construct, the items given to the experts are stated in Table 2.

Table 2. Items for the Incorporating Technology Construct

Construct	Item
IT1	Incorporating digital tools such as interactive whiteboards and multimedia software enhances the effectiveness of multimodal learning in academic writing classrooms.
IT2	Online collaborative platforms facilitate meaningful multimodal learning experiences for ESL foundation students in academic writing.
IT3	Proficiency in using technology is essential for educators to effectively implement multimodal learning approaches in ESL academic writing classrooms.
IT4	Technology integration improves student engagement and participation in multimodal academic writing activities.
IT5	Digital feedback tools, such as annotation software and video feedback enhance learning outcomes in multimodal academic writing assignments.
IT6	The use of technology in multimodal learning promotes creativity and among ESL foundation students in academic writing.
IT7	Access to digital resources and tools supports differentiated instruction in multimodal academic writing classrooms.
IT8	ESL foundation students benefit from exposure to diverse digital media formats (e.g., text, images, videos) in multimodal academic writing tasks.
IT9	Technology-enabled peer collaboration enhances collaborative learning experiences in multimodal academic writing contexts.
IT10	Effective implementation of multimodal learning frameworks requires ongoing professional development for educators in utilizing digital tools and resources.

Table3. Findings of Expert Consensus on Incorporating Technology Construct

Item	Triangular Fuzzy Numbers		Condition of Defuzzification Process		
	Threshold Value, d	Percentage of Experts' Agreement, %	Fuzzy Number (A)	Ranking	Experts Consensus
IT1	0.050	100.0%	0.782	2	Accepted
IT2	0.000	100.0%	0.800	1	Accepted
IT3	0.000	100.0%	0.800	1	Accepted
IT4	0.000	100.0%	0.800	1	Accepted
IT5	0.000	100.0%	0.800	1	Accepted
IT6	0.000	100.0%	0.800	1	Accepted
IT7	0.000	100.0%	0.800	1	Accepted
IT8	0.000	100.0%	0.800	1	Accepted
IT9	0.000	100.0%	0.800	1	Accepted
IT10	0.000	100.0%	0.800	1	Accepted

The threshold value (d), expert consensus percentage, defuzzification and item position for the above items are shown in Table 2.

Condition:

Triangular Fuzzy Numbers

1) Threshold Value (d) ≤ 0.2

2) Percentage of Experts Consensus > 75%

Defuzzification Process

3) Fuzzy Score (A) $\geq \alpha$ – cut value = 0.5

Based on the findings presented in Table 3, all items recorded a Threshold (d) value of ≤ 0.2, indicating that each item successfully reached expert consensus (Chen & Lin, 2002). Additionally, the expert agreement percentage for all items exceeded 75%, and the defuzzification values were all greater than the α-cut threshold of 0.5. These results confirm that the items within the "incorporating technology" construct have garnered consensus from the experts. The items are then rank according to Table 3 as all items are on the same value except for IT1. Therefore, all items are shown in Table 4.

Table 4. Items Position by Priority

Sort by Priority	Item	Item Number
1	Online collaborative platforms facilitate meaningful multimodal learning experiences for ESL foundation students in academic writing.	IT2
2	Proficiency in using technology is essential for educators to effectively implement multimodal learning approaches in ESL academic writing classrooms.	IT3
3	Technology integration improves student engagement and participation in multimodal academic writing activities.	IT4
4	Digital feedback tools, such as annotation software and video feedback enhance learning outcomes in multimodal academic writing assignments.	IT5

5	The use of technology in multimodal learning promotes creativity and innovation among ESL foundation students in academic writing.	IT6
6	Access to digital resources and tools supports differentiated instruction in multimodal academic writing classrooms.	IT7
7	ESL foundation students benefit from exposure to diverse digital media formats (e.g., text, images, videos) in multimodal academic writing tasks.	IT8
8	Technology-enabled peer collaboration enhances collaborative learning experiences in multimodal academic writing contexts.	IT9
9	Effective implementation of multimodal learning frameworks requires ongoing professional development for educators in utilizing digital tools and resources.	IT10
10	Incorporating digital tools such as interactive whiteboards and multimedia software enhances the effectiveness of multimodal learning in academic writing classrooms.	IT1

Items in Table 4 are the aspects of incorporating technology construct arranged based on the initial proposed items in developing the Multimodal Learning Framework.

6.3 Analysis of Expert Consensus on Aesthetic Value Construct

The following Table 6 illustrates the experts' evaluation of the items of aesthetic value construct.

Table 5. Items for the Aspect of Aesthetic Value Construct

Construct	Item
AV1	The aesthetic quality of multimodal academic writing assignments influences student motivation and engagement.
AV2	Visual design elements (such as layout, typography, and colour schemes) significantly impact the effectiveness of multimodal academic writing projects.
AV3	Incorporating aesthetically pleasing visuals enhances comprehension and retention of academic writing content among ESL foundation students.
AV4	Aesthetic considerations in multimodal academic writing contribute to the overall learning experience by stimulating student creativity.
AV5	The use of multimedia (e.g., images, videos, infographics) enhances the aesthetic appeal and effectiveness of academic writing assignments for ESL learners.
AV6	Aesthetic coherence across multimodal academic writing tasks promotes a more cohesive and impactful learning environment.
AV7	ESL foundation students benefit from exposure to diverse aesthetic styles and techniques in multimodal academic writing assignments.
AV8	The aesthetic presentation of information in multimodal academic writing fosters critical thinking and analytical skills among ESL learners.
AV9	Educators should prioritize teaching students how to effectively integrate aesthetic elements into their multimodal academic writing projects.

AV10	A balance between aesthetic appeal and content relevance is crucial for the success of multimodal academic writing assignments in ESL contexts.

Table 6. Findings of Expert Consensus on Aesthetic Value Construct

Item	Triangular Fuzzy Numbers		Condition of Defuzzification Process		
	Threshold Value, d	Percentage of Experts' Agreement, %	Fuzzy Number (A)	Ranking	Experts Consensus
AV1	0.136	90.9%	0.745	4	Accepted
AV2	0.182	81.8%	0.636	6	Accepted
AV3	0.242	81.8%	0.691	7	Accepted
AV4	0.091	100.00%	0.764	2	Accepted
AV5	0.050	100.00%	0.782	1	Accepted
AV6	0.182	81.8%	0.727	6	Accepted
AV7	0.101	90.91%	0.764	3	Accepted
AV8	0.242	90.91%	0.691	8	Accepted
AV9	0.162	100.00%	0.727	5	Accepted
AV10	0.050	100.00%	0.782	1	Accepted

The threshold values (d), expert consensus percentage, defuzzification and item position for the above items are shown in table 6.

Condition:

Triangular Fuzzy Numbers

1) Threshold Value (d) ≤ 0.2

2) Percentage of Experts Consensus > 75%

Defuzzification Process

3) Fuzzy Score (A) ≥ α – cut value = 0.5

Based on the findings presented in Table 6, all items recorded a Threshold (d) value of ≤ 0.2, indicating that each item successfully reached expert consensus (Chen & Lin, 2002). Additionally, the expert agreement percentage for all items exceeded 75%, and the defuzzification values were all greater than the α-cut threshold of 0.5. These results confirm that the items within the "aesthetic value" construct have garnered consensus from the experts. The items are then rank according to priority as shown in Table 7.

Table 7. Items Position by Priority

Sort by Priority	Item	Item Number
1	A balance between aesthetic appeal and content relevance is crucial for the success of multimodal academic writing assignments in ESL contexts.	AV10
2	The use of multimedia (e.g., images, videos, infographics) enhances the aesthetic appeal and effectiveness of academic writing assignments for ESL learners.	AV5
3	Aesthetic considerations in multimodal academic writing contribute to the overall learning experience by stimulating student creativity.	AV4

4	ESL foundation students benefit from exposure to diverse aesthetic styles and techniques in multimodal academic writing assignments.	AV7
5	The aesthetic quality of multimodal academic writing assignments influences student motivation and engagement.	AV1
6	Educators should prioritize teaching students how to effectively integrate aesthetic elements into their multimodal academic writing projects.	AV9
7	Visual design elements (such as layout, typography, and color schemes) significantly impact the effectiveness of multimodal academic writing projects.	AV2
8	Aesthetic coherence across multimodal academic writing tasks promotes a more cohesive and impactful learning environment.	AV6
9	Incorporating aesthetically pleasing visuals enhances comprehension and retention of academic writing content among ESL foundation students.	AV3
10	The aesthetic presentation of information in multimodal academic writing fosters critical thinking and analytical skills among ESL learners.	AV8

Based on Table 7, the application of aesthetic value construct is arranged based on priority when developing and designing the Multimodal Learning Framework.

6.4 Analysis of Expert Consensus on Integration of Artificial Intelligence

The following Table 8 illustrates the analysis of the experts' evaluation on the items of the Integration of Artificial Intelligence construct.

Table 8. Items for the Aspect of the Integration of Artificial Intelligence Construct

Construct	Item
IAI1	AI technologies can enhance the personalized learning experience in multimodal academic writing contexts for ESL foundation students.
IAI2	Automated grading systems powered by AI algorithms provide timely feedback on multimodal academic writing assignments.
IAI3	AI-driven content recommendation systems help ESL learners discover relevant multimodal resources for academic writing.
IAI4	Natural language processing (NLP) algorithms in AI support ESL students in improving their writing skills across different modes (text, audio, visual).
IAI5	AI-based virtual assistants can facilitate interactive learning experiences in multimodal academic writing classrooms.
IAI6	AI tools for plagiarism detection enhance academic integrity in multimodal assignments for ESL foundation students.
IAI7	Adaptive learning platforms powered by AI algorithms personalize multimodal academic writing instruction based on individual student needs.
IAI8	AI-enabled analytics provide educators with insights into ESL learners' engagement in multimodal academic writing tasks.

IAI9	Ethical considerations regarding AI use in multimodal academic writing should be addressed to ensure transparency for ESL students.
IAI10	Professional development programs for educators should include training on integrating AI tools effectively into multimodal learning frameworks for academic writing.

The threshold value (d), the percentage of expert consensus, defuzzification and item position for the above items are shown in Table 8.

Table 9. Findings of Expert Consensus on Integration of Artificial Intelligence construct

Item	Triangular Fuzzy Numbers		Condition of Defuzzification Process		
	Threshold Value, d	Percentage of Experts' Agreement, %	Fuzzy Number (A)	Ranking	Experts Consensus
IAI1	0.177	90.9%	0.709	8	Accepted
IAI2	0.136	90.9%	0.745	1	Accepted
IAI3	0.050	100.0%	0.782	2	Accepted
IAI4	0.242	72.73%	0.691	10	Rejected
IAI5	0.050	100.00%	0.782	3	Accepted
IAI6	0.182	90.91%	0.691	9	Accepted
IAI7	0.151	100.00%	0.709	4	Accepted
IAI8	0.101	90.91%	0.764	5	Accepted
IAI9	0.000	100.00%	0.800	6	Accepted
IAI10	0.000	100.00%	0.800	7	Accepted

Condition:

Triangular Fuzzy Numbers

1) Threshold Value (d) ≤ 0.2

2) Percentage of Experts Consensus > 75%

Defuzzification Process

3) Fuzzy Score (A) $\geq \alpha$ – cut value = 0.5

Based on the findings presented in Table 9, nine items recorded a Threshold (d) value of ≤ 0.2, indicating that each item successfully reached expert consensus (Chen & Lin, 2002). However, item IAI4 recorded a Threshold (d) value of > 0.2, therefore item is rejected. Additionally, the expert agreement percentage for all items exceeded 75%, and the defuzzification values were all greater than the α-cut threshold of 0.5. These results confirm that the items within the "integration of artificial intelligence" construct have garnered consensus from the experts. The items are then rank according to priority as shown in Table 10.

Table 10. Items Position by Priority

Sort by Priority	Item	Item Number
1	Automated grading systems powered by AI algorithms provide timely feedback on multimodal academic writing assignments.	IAI2
2	AI-driven content recommendation systems help ESL learners discover relevant multimodal resources for academic writing.	IAI3

3	AI-based virtual assistants can facilitate interactive learning experiences in multimodal academic writing classrooms.	IAI5
4	Adaptive learning platforms powered by AI algorithms personalize multimodal academic writing instruction based on individual student needs.	IAI7
5	AI-enabled analytics provide educators with insights into ESL learners' engagement in multimodal academic writing tasks.	IAI8
6	Ethical considerations regarding AI use in multimodal academic writing should be addressed to ensure transparency for ESL students.	IAI9
7	Professional development programs for educators should include training on integrating AI tools effectively into multimodal learning frameworks for academic writing.	IAI10
8	AI technologies can enhance the personalized learning experience in multimodal academic writing contexts for ESL foundation students.	IAI1
9	AI tools for plagiarism detection enhance academic integrity in multimodal assignments for ESL foundation students.	IAI6
10	Natural language processing (NLP) algorithms in AI support ESL students in improving their writing skills across different modes (text, audio, visual).	IAI4

The items in Table 10 consists of the items for the aspects of interactivity interface design that need to be emphasised according to priority by the researcher in developing the Multimodal Learning Framework on the Integration of Artificial Intelligence construct.

DISCUSSION

From the findings of the analysis using the fuzzy Delphi technique carried out, the results showed that all the elements need to be applied in designing the development of the *Multimodal Learning Framework*. On the aspects of incorporating technology construct, the experts agreed that these should include digital tools such as interactive whiteboards, online collaborative platforms, digital feedback tools, that will assist students in learning writing in the classroom. The effects of collaborative writing supported by interactive whiteboard technology on students' writing performance using IWBs in collaborative writing exhibited higher levels of engagement and improved writing outcomes compared to traditional methods (Fatih Saltan, 2019). Besides, the use of digital tools and online platforms for collaborative writing instruction among ESL students showed that collaborative writing fosters engagement and ownership of the writing process, making it a valuable approach for developing writing skills in ESL learners (Jalil & Mohamad, 2024). The technology integration had showed that it improves student engagement and participation in multimodal academic writing activities. The importance of integrating non-linguistic multimodal resources in writing instruction for English learners had emphasizes that educators must be adept at using various technological tools to facilitate multimodal composing, which enhances students' engagement and writing proficiency (Smith et al., 2021).

Moreover, the aesthetic value construct findings show that the main focus in designing the Multimodal Learning Framework is to consider incorporating the element of aesthetic value.

Multimodal writing assignments, which incorporate images, videos, and other visual elements, can enhance academic writing skills among ESL students. The findings suggest that the use of aesthetically appealing visuals stimulates student creativity, leading to more engaging and effective multimodal compositions (Tan,2003). The experts also recommended that incorporating aesthetically pleasing visuals enhances comprehension and retention of academic writing content among ESL foundation students.

Meanwhile, for the aspect of integrating the artificial intelligence in the Multimodal Learning Framework, AI technologies had showed that it could enhance the personalized learning experience in multimodal academic writing contexts for ESL students. Arslan (2020) discusses how multimodal writing practices positively affect writing skills and learner motivation. The research highlights that integrating various modes, including visual and auditory elements, can enhance the writing process for EFL learners. Although the primary focus is on multimodal writing, the findings suggest that utilizing technology and diverse modes can lead to improved writing outcomes, which aligns with the benefits of AI technologies in personalizing learning experiences. The experts emphasised developing AI-driven content recommendation systems that help ESL learners discover relevant multimodal resources for academic writing. Varaporn and Sitthitikul (2020) highlights the importance of multimodal tasks in developing critical reading and writing skills. The authors suggest that incorporating AI-driven feedback systems can enhance students' learning experiences by providing immediate insights into their writing performance.

CONCLUSION

In conclusion, the integration of digital tools, such as interactive whiteboards, online collaborative platforms, and digital feedback mechanisms, is not merely a supplementary aspect but a core component in transforming traditional writing instruction. These tools enhance student engagement, foster collaboration, and provide timely feedback, all of which are critical for developing writing proficiency. The study by Gökçen Göçen et al. (2023) discusses how digital tools, including interactive platforms, improve teachers' digital writing skills and positively affect students' writing experiences. The findings suggest that technology facilitates creative writing practices, leading to better engagement and outcomes for students (Göçen et al., 2023).

Moreover, the importance of aesthetic value in the framework by incorporating visually appealing elements, such as layout design, typography, and color schemes, plays a significant role in enhancing students' comprehension and retention of academic content. The emphasis on aesthetics supports the growing recognition of visual literacy as an essential component of effective multimodal learning, particularly in fostering creativity and engagement among students (Tan, 2003). Besides, the integration of artificial intelligence had further enhances the personalized learning experience for ESL students. AI-driven content recommendation and feedback systems provide targeted, real-time insights that help students improve their writing skills. This personalization aligns with the educational trend towards adaptive learning technologies, which aim to meet the diverse needs of learners by offering tailored support and resources (Arslan, 2020).

Overall, the study's findings advocate for a comprehensive, multimodal approach to teaching writing that incorporates technology, aesthetic considerations, and AI. This approach not only reflects current pedagogical trends but also addresses the specific needs of ESL learners by providing a more engaging, supportive, and effective learning environment. The Multimodal

Learning Framework developed through this study holds significant potential for enhancing the teaching and learning of writing in ESL contexts, thereby contributing to the broader field of language education and instructional design.

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