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The impact of design and implementation of online peer feedback based on digital modules on the quality of essay writing

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ABSTRACT

The purpose of this study was to investigate the impact of the design and implementation of online peer feedback strategies based on digital modules on the quality of essay writing. This study used a quasi-experimental method involving 200 junior high school students and 200 vocational high school students. To analyze the data, the one-way MANCOVA test, two-way MANCOVA test, and one-way MANCOVA test were employed. The results show that the digital online peer feedback module helped students write better argumentative essays and learn how to provide insightful criticism. The improvement in the quality of students' argumentative essays is evident in the introduction, position determination, arguments for the position, evidence or facts to support the position argument, arguments against the position, supporting arguments against the position, responses to counterarguments, and conclusions. Thus, online peer feedback strategies based on digital modules can improve essay writing skills because they focus on argumentative essay structure and content, so they can be used at various levels and subject areas. This study implies that online scaffolding in the form of digital modules must focus on the framework of text structure because knowledge and use of text structure can be transferred to students with different levels and domains of knowledge.

Contribution/Originality: This study contributes to media that can be used to improve essay writing skills, specifically digital modules that provide online peer feedback guidance. The originality of this study lies in the design of online peer feedback in the form of a digital module to enhance essay writing skills.

1. INTRODUCTION

Argumentation skills are very important for middle school students because, at this level, students are faced with more complex language tasks. Students at the middle school level are expected to be able to think critically, have a point of view on issues, and defend their point of view with various elements, such as arguments, scientific evidence, and other facts (Awada & Diab, 2021; Hadianto, Damaianti, Mulyati, & Sastromiharjo, 2021). Previous studies have revealed that argumentation skills positively impact thinking skills, domain knowledge levels, academic achievement, and academic performance (Pham, 2021). Students' argumentation skills can be trained, one of which is through essay writing. Based on previous studies, most middle school students still have difficulty writing argumentative essays, especially in constructing arguments logically and rationally based on a good argumentative structure (Danka, 2020; Rahimi, Fathi, & Zou, 2025). This is due to several factors, including a lack of understanding of quality structures, strategies, domain knowledge, and media or applications to facilitate students. Peer feedback is one of the learning

strategies that is considered effective in improving the quality of students' essay writing. Online peer feedback in large-scale classes is a challenge for teachers (Han & Xu, 2019; Latifi, Noroozi, Hatami, & Biemans, 2019). Teachers will find it difficult to guide or provide feedback to students on a large scale. Previous studies have revealed that peer feedback supported by other media can produce high-quality support. However, this approach often leaves students unable to comprehend the structure and characteristics of peer feedback, as well as how to give it effectively.

Based on previous studies, students really need support, guidance, and materials as a guide to improve their essay writing skills. Some literature indicates that online peer feedback can enhance writing skills (Pham, 2021). However, these results are also likely to be influenced by other variables, such as domain knowledge, writing experience, and other scaffolds. This suggests that peer feedback can produce different writing competencies depending on other factors. Online peer feedback requires specific support that can serve as a guide for students in providing feedback. Several previous studies have investigated whether this feedback can improve the quality of students' writing, but most of these studies have only focused on the competency variable or approach and have not identified many variables that could fill the gap of a comprehensive feedback tool capable of accommodating large-scale classes and various knowledge domains (Han & Xu, 2019). So, through this study, researchers designed a digital module (teaching material) as a scaffolding guideline for conducting online peer feedback. By using the digital module scaffolding to guide feedback, it will be more effective in utilizing feedback (Valero Haro, Noroozi, Biemans, Mulder, & Banihashem, 2023). Based on this justification, the researcher created a digital online peer feedback module scaffold to enhance essay writing abilities and improve the quality of peer feedback. The researcher formulated several problem statements, including.

a) How effective is the digital module design in improving the ability to write argumentative essays?
b) How effective is the digital module design in improving the quality of argumentative essay writing across various knowledge domains and educational levels?
c) What is the level of student learning satisfaction with the use of digital modules?

2. LITERATURE REVIEW

2.1. Online Peer Feedback

The process of giving peers verbal or written comments on their own work while also receiving input on their peers' work is known as peer feedback (Cuevas et al., 2024; Mayordomo, Espasa, Guasch, & Martínez-Melo, 2022). This feedback is intended to assist peers in identifying areas where their work is lacking and to help them close the performance gap between their current performance and the desired outcomes (Avcı, 2025; Yang, Gao, & Shen, 2024). Several previous studies have revealed that peer feedback has a significant impact on the learning process across various language learning topics (Babik et al., 2024; Evmenova, Regan, Mergen, & Hrisseh, 2024). Feedback will be of higher quality if it is given on target and of high quality. High-quality feedback has several features, including positive sentences or affective feedback, cognitive feedback, constructive feedback on problems and gaps in work results, and suggestions for improvement in enhancing performance results (Holdinga, van Drie, & Rijlaarsdam, 2025; Li & Hebert, 2024). Based on current research trends, peer feedback research has developed and changed. Peer feedback is not only conducted offline but also expanded in the online context, which is developing significantly.

The development of this study is due to the demands of technological advancements and the integration of technology into the educational process, as well as the need to accommodate students on a larger scale. This online class is considered to be more effective for teachers to facilitate their students' learning process (Evmenova et al., 2024; Sato, 2022). Peer feedback is considered to be one of the effective learning strategies in improving students' writing skills, but there must be guidance for students in doing so (Chen & Pan, 2022; Wang & Li, 2022). This guide can take various forms, such as modules or frameworks. Peer feedback can improve the quality of student performance in the online learning process with a large number of students. In the online learning process, students can provide both synchronous and asynchronous feedback in various formats. Currently, the most widely used feedback is

asynchronous written feedback (Peungcharoenkun & Waluyo, 2023; Thi & Nikolov, 2023). This happens because this written and asynchronous feedback is a feedback format whose feedback complexity is effective and constructive, so that the cognitive workload encourages students to use their time more freely to think about it carefully. This asynchronous communication is able to provide students with time and opportunity to reflect and analyze input better so that it can improve the quality of student writing.

2.2. Online Peer Feedback in Essay Writing Learning

Students' argumentative abilities can be developed through various methods, one of which is learning to write argumentative essays. Writing such essays is a crucial skill because it trains students to make claims on important issues, support their claims with evidence and facts, and present logical and rational opinions when providing counterarguments (Liu, 2024). A quality argumentative essay has several structures, including starting with an introduction about the topic, providing a claim from one point of view, offering arguments for or against that point of view, and ending with a conclusion. To achieve writing competency with this structure, students need good support and guidance (Valero Haro, Noroozi, Biemans, & Mulder, 2018). Their capacity to compose persuasive articles may be enhanced by this online peer review. Students will engage in a variety of feedback process activities through peer feedback exercises, such as concentrating on their peers' essays, evaluating their quality, pointing out issues, and offering recommendations for improvement. When their writings are reviewed, students use the criticism from their peers to improve their essays. Critical thinking skills are necessary for this online peer review process to be effective and focused. Quality feedback requires critical thinking skills so that the problem identification process is carried out appropriately (Mulyati & Hadianto, 2023; van Heerden & Bharuthram, 2021). In addition, this critical thinking ability plays a very important role in providing constructive input to facilitate their peers in overcoming their shortcomings.

The uneven and shallow quality of feedback is caused by students' lack of expertise and experience. Quality feedback is feedback that has clear criteria, a good structure, and a high-quality method of delivery (Awada & Diab, 2021; Pham, 2021). Students who receive structured and clear feedback will become more focused on important components such as content quality, essay structure, and argument quality. Several previous studies have investigated that this feedback can improve the quality of students' writing, but most of these studies have only focused on competency variables or approaches, and have not revealed many variables that can fill the gap of comprehensive feedback tools that can accommodate large-scale classes and be used in various knowledge domains. The feedback tools that were previously investigated also only focused on the context and content of one domain, which would cause weak feedback if applied to other fields.

However, based on other studies, this argumentation structure cannot only be transferred to different subjects but also to different levels. The general structure of an argumentative essay is an introduction, determining the position of the point of view, providing supporting arguments, presenting counterarguments, providing responses to counterarguments, and concluding. This structure can be used by students with various knowledge backgrounds and different levels (Han & Xu, 2019).

3. METHODOLOGY

3.1. Design and Participants

The research method used in this study is a quasi-experimental approach to test the designed online peer feedback digital module. The assessment includes a pretest and posttest in writing argumentative essays. Additionally, this study evaluates the effectiveness of the feedback module in improving students' ability to write argumentative essays. The study involved students from two levels: junior high school and high school.

There were 200 junior high school students and 200 high school students, totaling 400 participants. Junior high school students ranged in age from 13 to 15 years, while vocational high school students ranged from 16 to 19 years. The topics used for learning to write essays included several controversial and complex issues.

Table 1. Characteristics of research participants.

Class issue	Level		Gender	
	Junior high school	Vocational high school	F	M
Class A (Social)	50	50	55	45
Class B (Sciences)	50	50	60	40
Class C (Health)	50	50	58	42
Class D (Environmental)	50	50	60	40
Total	200	200	233	167

Table 1 presents the distribution and characteristics of the participants. Participants were divided into four groups, each consisting of 100 students with different topics. The junior high school level includes groups A and B, while the vocational high school level includes groups C and D. The division of essay topics comprises group A (social topics), group B (science topics), group C (health topics), and group D (environmental topics). The diversity of school levels and essay topics aims to investigate the impact of the digital feedback module on different knowledge domains and educational levels. All participants involved in this study have signed the consent form, indicating voluntary participation. This study has also received approval from the involved school institutions and Universitas Muhammadiyah Prof. Dr. Hamka, ensuring compliance with research ethics standards. The data collected is anonymous and used solely for research purposes to maintain participants' privacy.

3.2. Design and Implementation of Digital Modules

The design of the module is based on the results of theoretical studies and research on several studies that align with peer feedback and argumentative essays. The optimal design and requirements to improve the standard of essay writing on a broad scale were identified through reviewing previous research. Based on these theoretical studies, researchers constructed a scaffolding for the peer feedback digital module, grounded in prior research. Several questions were used to incorporate the components of quality argumentative essay writing. The digital feedback module is designed around eight components: introduction, position determination, supporting arguments, evidence or facts supporting position arguments, counterarguments, supporting arguments against positions, responses to counterarguments, and conclusions. Although the module was developed based on previous studies, this research has some differences, including variations in the introductory components, feedback tools that determine positions, and the inclusion of counterargument components. The introductory component emphasizes motivational, controversial, and social aspects, which can enhance the quality of the introduction. Additionally, the digital module emphasizes positioning on the topic, where determining a stance either supporting or opposing can lead to stronger and more logical argumentative claims in essay writing.

3.3. Instrument Assessment

3.3.1. Assessment of Argumentative Essay Writing Skills

Students' argumentative essay writing is assessed using established coding. The coding scheme in essay writing assessment is presented in Table 3 with eight components of a quality argumentative essay structure. The coding components used are 1. introduction to the issue, 2. determination of the issue's position, 3. arguments supporting the position, 4. justification of the position argument, 5. arguments opposing the position, 6. justification of the arguments opposing the position, 7. responses to opposing arguments, and 8. conclusions/implications. Each component is scored with a range of 0-3 points, as explained in Table 3. Peer feedback is carried out based on the following analysis codes: 0 = Not mentioned at all, 1 = Mentioned only, 2 = Mentioned and explained, 3 = Mentioned, explained, and justified. The quality of the writing outcomes for the argumentative essay is determined by the average value of all components. Five educators participated in the pretest and posttest to evaluate the essay writing samples. Contingency coefficient analysis was used to test the reliability between assessors. Based on the results of the analysis, a reliable agreement was found between assessors with a p-value < 0.001.

3.3.2. Assessment of Student Learning Satisfaction

Student learning satisfaction was assessed using a questionnaire adapted from Mahdizadeh (2008). The questionnaire was modified according to four main categories, with a total of 25 items rated on a 5-point Likert scale. On this scale, 1 indicates 'never true' and 5 indicates 'nearly always true.' Items 6–11 evaluate the influence of domain-specific learning on general domain learning, items 12–16 assess the module's usability, items 17–25 measure student satisfaction with learning tasks, and five items gauge students' attitudes toward domain-specific learning. A panel of specialists, including educators, subject matter experts, and educational research experts, evaluated the survey's validity.

3.4. Procedure

After the feedback module was designed, the next step was to implement the digital module for students to improve their argumentative essay writing skills. The module was used in the Brightspace online learning platform. The researcher provided an introductory explanation of the module, which included instructions on the procedures and actions that students should take. These instructions covered the research setting, objectives, tasks within the module, instructions for actions based on the module, the required number of words in the essay, feedback provided by students, and the deadline for submitting the assignment. In the first assignment, students were instructed to write an argumentative essay independently on one of the controversial issues. The issues provided included four categories: social issues (use of video games in children, genetic engineering of organisms, and climate change), natural issues (use of pesticides, ban on glyphosate, use of pest control drugs), health issues (use of vaccines, consumption of sugar), and environmental issues (impact of the COVID vaccine on the environment, impact of waste on the environment, local and global biodiversity).

Table 2. Components rubric for online peer feedback.

Components of an argumentative essay	Argumentative essay checker questions
Introduction to the issue	How is the presentation of your colleague's issue introduction considering the motivational, interest, and social aspects of the issue at hand? Explain your suggestion!
Positioning the issue	How clear is the positioning of your colleague's issue? Does it support or oppose the issue? Explain your suggestion!
Arguments supporting the position	How is the quality of your friend's argument in strengthening his position on the issue? Explain your suggestion!
Justification of the position argument.	How is the quality of your colleague's reinforcement (facts, evidence, data, experience) in the arguments supporting his position?
Arguments opposing the position (Counterarguments)	How is the quality of the arguments opposing your colleague's position? Explain your suggestion!
Justification of the position argument.	How is the quality of the reinforcement (facts, evidence, data, experience) of the arguments opposing his position? Explain your suggestion!
Response to the counterargument	How is the quality of your colleague's response to the counterarguments to his position? Explain your suggestion!
Conclusion and implications of the issue	How are the conclusions and implications (suggestions for action) that support his claim position? Explain your suggestion.

Students are placed randomly, and the Brightspace application is used to provide feedback. One of the external technologies of the Brightspace application is the feedback tool. This application has several functions, including conducting peer reviews, reviewing assignments, assessing writing skills, providing automatic feedback, interactive videos, interactive documents, conducting assignment discussions, and facilitating interactive presentations. Through this application, teachers can provide rubrics as guidelines and give instructions to students to review their peers' writing in various formats such as images, videos, reports, and essays. The word limit for essays is 850 words, including references. In the first stage, students are asked to write according to their abilities as pretest material.

Next, using the feedback rubric shown in Table 2, students are requested to give written, asynchronous comments on two argumentative essays belonging to their classmates. The feedback assignment is conducted over one week, allowing students time to reflect on the peer essays they review, as feedback requires high-level and complex cognitive skills. The number of words used in providing feedback should be between 40 and 60 words.

3.5. Data Analysis

The data analysis used in this study includes two phases. The first phase involves a qualitative analysis of the assessment of qualitative data obtained from the argumentative essay writing coding scheme. The coding scheme was used to score each essay component. From the assessment results, researchers can evaluate the progress of students' writing skills from the pretest to the posttest stage. Furthermore, the second phase involves a quantitative analysis by examining descriptive statistics, including the mean and standard deviation of each variable from the pretest to the posttest stage, as well as student learning satisfaction considering the domain of knowledge and level of education. The subsequent quantitative analyses include a one-way MANCOVA to assess the progress of essay writing skills from pretest to posttest, and a two-way MANCOVA to compare the impact of interventions on argumentative essay writing skills across specific domain aspects and different levels. Additionally, a one-way MANCOVA was conducted to investigate the impact of the digital feedback module intervention on student satisfaction in learning, focusing on specific domain aspects and levels. To examine variations in learning satisfaction across different topics and educational levels, paired comparison analysis was utilized.

3.6. Ethical Considerations

All participants were involved in this study voluntarily and without coercion. All participants filled out the consent form voluntarily to participate in this study. This study has received permission from the Vocational School Mulia Hati Insani educational institution, Lebak Banten, Indonesia. Additionally, the Ethical Committee of Universitas Muhammadiyah Prof. Dr. Hamka, Indonesia, granted approval for this study on February 4, 2024 (Ref. No. 1186/B.04.02/2024).

4. RESULT

To address the first problem formulation, the impact of the online peer feedback digital module on students' argumentative essay writing skills is presented through the pretest and posttest data shown in Table 4. Students' ability to write argumentative essays improved significantly from the pretest to the posttest phase, according to the analysis's findings (Wilks' $\lambda = 0.66$, $F(7, 270) = 21.62$, $p < 0.01$, Partial $\eta 2 = 0.37$). Not only did the quality of argumentative essay writing improve significantly, but all eight elements that contribute to better essay writing also showed notable gains. The effect size can be calculated using Cohen's guidelines, where 0.02 indicates a small effect, 0.07 a medium effect, and 0.15 a large effect on each measure of variance. Based on the analysis results, the $\eta 2$ Partial for the ability to write argumentative essays from pretest to posttest exceeds 0.15, indicating that the online peer feedback intervention based on this digital module has a large effect. The analysis results are presented in Table 3.

Furthermore, to address the second problem formulation, the researcher conducted an analysis of the impact of the online peer feedback digital module on the ability to write argumentative essays based on specific knowledge domains. The results of the analysis indicated that there was no significant difference in the ability to write argumentative essays across different knowledge domain issues, with values (λ Wilks = 0.89, $F(29, 967.90) = 1.32$, $p = 0.22$). From these findings, it can be concluded that the ability to write argumentative essays can be improved from the pretest to the posttest phase, regardless of differences in class issues. The results of the analysis are presented in Table 4.

Table 3. Differences in argumentative essay scores between the pretest and posttest phases.

Aspect	Phase	Mean	SD	Improvements of essay quality
Introduction to the issue	Pretest	2.85	0.63	$F(1, 382) = 22.87$, $p < 0.01$**,
	Posttest	2.93	0.37	$\eta 2 = 0.08$
Positioning the issue	Pretest	1.04	0.92	$F(1, 382) = 146.5$, $p < 0.01$**,
	Posttest	1.63	0.92	$\eta 2 = 0.35$
Arguments supporting the position	Pretest	2.72	0.73	$F(1, 382) = 5.63$, $p < 0.01$**
	Posttest	2.83	0.71	$\eta 2 = 0.03$
justification of the position argument	Pretest	2.42	0.94	$F(1, 382) = 32.82$, $p < 0.01$**,
	Posttest	2.62	0.76	$\eta 2 = 0.11$
Arguments opposing the position (Counterarguments)	Pretest	1.53	0.97	$F(1, 382) = 78.06$, $p < 0.01$**,
	Posttest	1.86	0.89	$\eta 2 = 0.22$
justification of the arguments opposing the position	Pretest	0.96	1.00	$F(1, 382) = 87.42$, $p < 0.01$**,
	Posttest	1.52	0.99	$\eta 2 = 0.24$
Responses to counterarguments	Pretest	1.06	0.90	$F(1, 382) = 48.03$, $p < 0.01$**,
	Posttest	1.42	0.88	$\eta 2 = 0.15$
Conclusion and implications of the issue	Pretest	1.97	0.63	$F(1, 387) = 53.84$, $p < 0.01$**,
	Posttest	2.35	0.52	$\eta 2 = 0.17$
Overall quality of the argumentative essay	Pretest	1.83	0.37	$F(7, 371) = 21.62$, $p < 0.01$**,
	Posttest	3.07	0.35	$\eta 2 = 0.36$

Note: $(P < 0.01)$**.

Table 4. Results of the analysis of essay writing ability based on differences in knowledge domains.

Variables	Test	Group								Difference in essay quality
		Class A		Class B		Class C		Class D		
		M	SD	M	SD	M	SD	M	SD	
Introduction to the issue	Pretest	2.83	0.40	2.93	0.40	2.82	0.62	2.84	0.54	$F(4, 271) = 0.75$, $p = 0.55$
	Posttest	2.90	0.30	2.94	0.31	2.92	0.52	2.95	0.38	
Positioning the issue	Pretest	0.95	0.83	0.76	0.92	1.05	0.82	1.24	0.92	$F(4, 272) = 1.01$, $p = 0.40$
	Posttest	1.62	0.83	1.04	1.02	1.71	0.97	1.77	0.83	
Arguments supporting the position	Pretest	2.73	0.62	2.60	0.75	2.62	0.73	2.82	0.73	$F(4, 271) = 2.15$, $p = 0.07$
	Posttest	2.86	0.54	2.72	0.83	2.62	0.70	2.78	0.56	
Justification of the position argument	Pretest	2.42	0.93	2.24	1.06	2.34	0.96	2.50	0.92	$F(4, 272) = 2.27$, $p = 0.06$
	Posttest	2.82	0.60	2.62	0.83	2.41	0.92	2.68	0.70	
Arguments opposing the position (Counterarguments)	Pretest	1.96	0.98	2.12	1.02	1.17	0.87	1.30	0.92	$F(4, 272) = 0.73$, $p = 0.57$
	Posttest	2.31	0.82	2.64	0.64	1.50	0.67	1.62	0.84	
Justification of the arguments opposing the position	Pretest	1.12	1.17	1.83	1.17	0.80	0.87	0.85	0.87	$F(4, 272) = 1.91$, $p = 0.10$
	Posttest	1.90	1.08	2.41	0.82	1.12	0.83	1.25	0.82	
Responses to counterarguments	Pretest	1.45	1.06	1.30	1.14	1.11	0.82	0.76	0.70	$F(4, 272) = 0.23$, $p = 0.91$
	Posttest	1.83	1.02	1.50	1.03	1.52	0.72	1.03	0.75	
Conclusion and implications of the issue	Pretest	2.14	0.42	2.02	0.75	1.91	0.70	1.93	0.71	$F(4, 273) = 0.57$, $p = 0.68$
	Posttest	2.42	0.50	2.32	0.42	2.31	0.57	2.31	0.56	
Overall quality of the argumentative essay	Pretest	1.93	0.40	1.93	0.43	1.70	0.30	1.84	0.42	$F(28, 956.89) = 1.21$, $p = 0.20$
	Posttest	2.30	0.40	2.34	0.42	1.97	0.30	1.98	0.32	

The researcher conducted an analysis of the impact of online peer feedback based on digital modules on the ability to write argumentative essays, considering the aspect of education level. The analysis's findings showed that there was no discernible difference between junior high and high school students' essay writing skills, based on the rise in the average essay quality score from the pretest to posttest phase (Wilks' $\lambda = 0.98$, $F(7,270) = 1.26$, $p = 0.30$). Nevertheless, a more thorough examination revealed that the argument justification component had improved more than the other components. Table 5 displays the analysis's findings.

Table 5. Results of essay writing ability analysis based on differences in education level.

Variables	Test	School level				Essay quality improvements
		Junior high school		Vocational high school		
		Mean	SD	Mean	SD	
Introduction to the issue	Pretest	2.63	0.50	2.76	0.57	F (1, 382) = 0.05, p = 0.48
	Posttest	2.92	0.40	2.90	0.42	
Positioning the issue	Pretest	1.10	0.82	0.98	0.89	F (1, 382) = 0.98, p = 0.45
	Posttest	1.71	0.87	1.48	0.92	
Arguments supporting the position	Pretest	2.64	0.64	2.65	0.67	F (1, 381) = 2.40, p = 0.13
	Posttest	2. 84	0.73	2.84	0.60	
Justification of the position argument	Pretest	2.45	0.92	2.31	0.96	F (1, 382) = 0.99, p < 0.05*, η2 = 0.03
	Posttest	2.62	0.85	2.62	0.83	
Arguments opposing the position (Counterarguments)	Pretest	1.32	0.92	1.83	1.02	F (1, 382) = 0.75, p = 0.40
	Posttest	1.63	0.82	2.18	0.92	
Justification of the arguments opposing the position	Pretest	0.83	0.87	1.10	1.14	F (1, 382) = 0.97, p < 0.05*, η2 = 0.02
	Posttest	1.23	0.91	1.73	1.10	
Responses to counterarguments	Pretest	0.82	0.73	1.32	1.04	F (1, 382) = 0.25, p = 0.64
	Posttest	1.24	0.84	1.50	0.98	
Conclusion and implications of the issue	Pretest	1.78	0.72	2.05	0.60	F (1, 382) = 0.70, p = 0.45
	Posttest	2.43	0.62	2.30	0.48	
Overall quality of the argumentative essay	Pretest	1.72	0.32	1.90	0.39	F (7, 379) = 1.25, p = 0.30
	Posttest	1.99	0.25	2.11	0.40	

Note: (P < 0.05)*.

The researcher examined how student learning satisfaction was affected by the online peer feedback module intervention. Considering the factor of educational level, the analysis's findings showed a significant difference in student learning satisfaction resulting from the intervention (Wilks' λ = 0.95, F (5,321) = 4.85, p < 0.01, Partial η2 = 0.06). High school students demonstrated greater learning satisfaction compared to high school pupils. The higher satisfaction at the high school level was attributed to effects on general domain learning and satisfaction with learning tasks. Based on the analysis results, the Partial η2 value for learning satisfaction concerning educational level was higher than 0.02, indicating that the effect size on learning satisfaction was within the small to medium range. The results of the analysis are presented in Table 6.

Table 6. Results of the analysis of differences in learning satisfaction at junior high and high school levels.

Variables	Level	Mean	SD	Learning satisfaction differences
Impact on specific domain learning outcomes	Junior	3.72	0.82	F (1, 346) = 2.82, p = 0.12
	Vocational	3.80	0.85	
	Total	3.72	0.80	
Impact on general domain learning outcomes	Junior	3.52	0.73	F (1, 345) = 7.40, p < 0.05*, η2 = 0.03
	Vocational	3.70	0.82	
	Total	3.60	0.78	
Ease of use of modules	Junior	4.06	0.75	F (1, 345) = 0.03, p = 0.90
	Vocational	5.04	0.80	
	Total	5.05	0.84	
Satisfaction with assigned tasks	Junior	3.50	0.63	F (1, 345) = 9.86, p < 0.01*, η2 = 0.05
	Vocational	3.82	0.73	
	Total	3.65	0.71	
Overall learning satisfaction	Junior	3.71	0.60	F (8, 370) = 21.61, p < 0.01**, η2 = 0.07
	Vocational	3.92	0.72	
	Total	3. 81	0.61	

Note: (P < 0.01)**, (P < 0.05)*.

Furthermore, based on the results of the analysis, a significant difference was found between the learning satisfaction of junior high and vocational high school students, with a value of Wilks' $\lambda = 0.75$, $F(17, 785{,}342) = 5.70$, $p < 0.01$, and Partial $\eta 2 = 0.08$. This difference in learning satisfaction is caused by the varying levels of students' understanding of the effects of the intervention on learning outcomes in the general domain and the learning tasks provided. Additionally, further analysis shows that the Partial $\eta 2$ value for students' learning satisfaction across different issue domains exceeds 0.03. This indicates that the intervention's effect on learning satisfaction is within the small to medium range. The results of the analysis of the effects of the intervention on learning satisfaction are presented in Table 7.

Table 7. Learning satisfaction in different issue domains.

Aspect	Group	Mean	SD	Pairwise comparisons	Learning satisfaction
Impact on specific domain learning outcomes	Class A	3.72	0.94	Class B > Class A*	F (5, 345) = 1.94, p = 0.12
	Class B	4.02	0.82	Class B > Class D*	
	Class C	3.70	0.78	-	
	Class D	3.62	0.73	-	
	Total	3.82	0.80	-	
Impact on general domain learning outcomes	Class A	3.91	0.82	Class A > Class B**	F (5, 240) = 5.034, p < 0.02**, η2 = 0.09
	Class B	3.42	0.81	Class A > Class C*	
	Class C	3.52	0.75	Class A > Class D**	
	Class D	3.51	0.83	Class D > Class C**	
	Total	3.62	0.98	-	
Ease of use of modules	Class A	4.10	0.82	Class D > Class B*	F (5, 240) = 1.42, p = 0.25
	Class B	3.82	0.84	Class D > Class C*	
	Class C	3.98	0.90	-	
	Class D	4.10	0.75	-	
	Total	4.05	0.78	-	
Satisfaction with assigned tasks	Class A	3.92	0.86	Class A > Class C*	F (5, 240) = 2.87, p < 0.05*, η2 = 0.05
	Class B	3.75	0.63	Class A > Class D*	
	Class C	3.51	0.73	Class D > Class B*	
	Class D	3.62	0.63	Class D > Class C*	
	Total	3.74	0.76	-	
Overall learning satisfaction	Class A	3.87	0.66	Class A > Class D*	F (17, 765.145) = 5.72, p < 0.01**, η2 = 0.08
	Class B	3.76	0.63	Class D > Class C*	
	Class C	3.62	0.76	-	
	Class D	3.64	0.61	-	
	Total	3.82	0.60	-	

Note: (P < 0.01)**, (P < 0.05)*.

5. DISCUSSION

The purpose of this study was to determine how effectively a digital peer feedback module can assist students learning online, particularly those with a large number of participants from various educational levels, in writing argumentative essays. The study involved a diverse group of participants with varying levels of domain knowledge. Results from the initial draft through to the revision stage indicated that the digital peer feedback module could improve students' ability to write argumentative essays across all components. It can be inferred that students provided useful feedback based on the digital module. Improvements were observed in the quality of the introduction, issue placement, and arguments within the argumentative essay structure. These findings align with previous research demonstrating that peer review can enhance students' argumentative writing skills (Latifi et al., 2019; Mohamadi Zenouzagh, 2020). The findings of previous studies revealed that offline and online feedback can improve the quality of students' essay writing. Improving the quality of students' argumentative essay writing is highly dependent on the quality of the feedback scaffolding built based on studies of previous research, theories, and practices (Huang & Jun Zhang, 2019; Lu & Xie, 2019). The findings of this study are supported by several previous studies

that demonstrate that scaffolding, in the form of frameworks, guidelines, and other supports, can improve students' writing skills.

The next finding is that the intervention of this digital peer feedback module did not reveal a significant difference in the abilities of students with different knowledge domains. This indicates that this peer feedback module has a consistent significant impact, even though the knowledge issues being discussed vary. This finding confirms that the scalability of the digital module used as a peer feedback guideline can improve the quality of argumentative essay writing regardless of the issues or fields being discussed (Huang & Jun Zhang, 2019; Lu & Xie, 2019). This finding contradicts several previous studies that show that subject domain knowledge impacts the quality of feedback provided and students' essay writing skills (Han & Xu, 2019). Other research results also support the idea that students with more domain knowledge may give higher-quality comments than those with less domain expertise (Karaman, 2024; Latifi et al., 2019). Specific domain knowledge has a positive correlation with argumentation skills. The reason this study was able to improve the quality of essay writing and feedback, even though the knowledge domains were different, is that the digital module created was capable of accommodating both specific and general domains, as well as various essay structures and quality feedback.

The idea that students can transfer their persuasive skills from one area of knowledge to another, provided they obtain good argument structure help and coaching, also supports the conclusion that the digital feedback module can enhance essay writing quality (Valero Haro et al., 2023). In addition, this online peer feedback encourages students to carry out various pedagogical activities with a process orientation, which includes activities to provide feedback, collaborate critically and actively, and encourage high-level cognitive abilities such as criticism, reflection, analysis, and evaluation activities (Cuevas et al., 2024; Karaman, 2024). These activities are capable of developing skills in providing quality feedback and enhancing students' argumentative writing skills in both specific and general domains. The next finding is that the digital feedback module effectively facilitates students at both junior high and high school levels to improve their essay writing skills from the pretest to the posttest. This indicates that the scaffolding provided by this digital feedback module can enhance the quality of feedback, thereby improving the ability to write argumentative essays regardless of students' differences in experiences, strategies, motivations, and beliefs about writing (Mayordomo et al., 2022; Rahimi et al., 2025).

Differences in components based on this level are only found in the components used to justify arguments to strengthen the position of the claim that the high school level is better than the junior high school level because one of the factors is writing experience. Based on these results, students of varying skill levels can utilize this peer feedback tool. Numerous earlier studies have confirmed this conclusion, demonstrating that feedback interactions facilitated by ICT will enhance students' writing abilities (Li & Hebert, 2024; Yang et al., 2024). The next finding is that high school students show greater learning satisfaction compared to junior high school students. High school students consider this digital module to be more effective in achieving students' general domain learning objectives. The differences in learning satisfaction experienced by students are influenced by several factors, including education level, knowledge domain, and learning experience (Danka, 2020; Holdinga et al., 2025). This finding aligns with previous studies indicating that learning scaffolds used by students at various levels and in different areas of knowledge elicit different responses (Babik et al., 2024; Evmenova et al., 2024).

6. CONCLUSION, IMPLICATION, AND RECOMMENDATION

The digital module for online peer feedback effectively facilitates students in improving their ability to write argumentative essays and guides them in creating quality feedback. The enhancement in students' essay quality is evident in aspects such as the introduction, position determination, supporting arguments, evidence, counterarguments, responses, and conclusions. The designed digital module has demonstrated its capacity to transfer argumentation skills by emphasizing the structure of argumentative essays rather than just content, thereby improving students' writing skills across various levels and domains of knowledge. This study suggests that online

scaffolding through digital modules should focus on the framework of text structure, as knowledge and application of text structure can be transferred to students with different levels and disciplines. Additionally, digital scaffolding and online practice can facilitate teachers in providing guidance on a broader scale. Effective scaffolding by teachers should be adaptable to different contextual learning environments. Overall, the design of this online peer feedback digital module significantly contributes to the practice of teaching language competence online with greater scalability. The study has several limitations, including the focus on variables related to the design of the digital feedback module scaffolding across various knowledge disciplines and levels, the emphasis on structure in the digital module, unexamined feedback features, and limited issues addressed. Based on these limitations, the researcher recommends investigating the impact of the digital module on students' epistemic beliefs and feedback culture, which may influence argumentative essay writing performance. Furthermore, the digital module should be expanded to address other aspects beyond structure, including feedback features such as affective, cognitive, and constructive elements that can enhance the quality of argumentative essays. The digital feedback module should also be tested with a wider range of topics and difficulty levels to gather more comprehensive data.

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